SOUTH CENTRAL RAILWAY

STUDY MATERIAL ON DIESEL LOCOMOTIVES FOR RUNNING STAFF

DIESEL TRACTION TRAINING CENTRE
GUNTAKAL

MESSAGE

This book is quite interesting to learn the basic principles of working, operating and trouble shooting on both electrical and mechanical systems of Diesel locomotives. This book has been framed scientifically, well graded to suit different courses and age groups, also in accordance with new training policy and meet the needs of all cadres of running staff.

I hope that the Second edition of this book is quite helpful and brings glimpse of knowledge for both inspectors and trainees.

B. LACHIRAM IRSME
Sr.Divisional Mechanical Engineer
Diesel Loco Shed, Guntakal

PREFACE



This study material has been made keeping in view in the requirements of the drivers and assistant drivers of diesel- electrical locomotives. This includes mechanical and electrical and running portion of the Diesel electric locomotives in brief. Additional items like TRAIN HANDLING METHODS, DRIVING TECHNIQUES, SPEEDOMETERS, AUTOFLASHERS, TWIN BEAM HEAD LIGHT, AC/DC LOCO MOTIVES, MCBG GOVERNORS, MICRO-PROCESSOR CONTROL SYSTEM, WDG-4, WDP-4 LOCOMOTIVES, RAKSHAKAVACH, FIRE FIGHTING, YOGA AND ALCHOLISM have been include for guidance of crews.

Care has been taken while preparing the study material. However, any suggestion for improvement will be heartily welcomed.

This is only a guide for crew's and contents of this booklet do not supersede any instructions issued by **RDSO, DLW, ZONAL HEAD QUARTERS, DIVISIONAL HEAD QUARTERS, RAILWAY BOARD and CAM TECH.**

E. Prasad
Principal & DME/Dsl/GTL
Diesel Traction Training Centre
Guntakal

Date : 24.02.11.

INDEX

MECHANICAL

		Page No.
1.	ENGINE BASICS	1-10
2.	FUEL OIL SYSTEM	11-15
3.	LUBE OIL SYSTEM	16-22
4.	COOLING WATER SYSTEM	23-27
5.	CHARGE AIR SYSTEM	28-32
6.	EXPRESSOR	33-38
7.	BRAKE SYSTEM VALVES	39-43
8.	BRAKE SYSTEM	44-53
9.	GOVERNOR	54
10.	UNDER TRUCK	55-59
11.	TROUBLE SHOOTING (MECH)	60-62
12.	WDG4 / P4	
	• Fuel Oil system	63-65
	• Lube oil system	66-69
	• Cooling water system	70-72
	• Air intake system	73-75

ELECTRICAL

1.	FUNDAMENTALS OF ELECTRICITY	77-84
2.	LOCOMOTIVE BATTERIES	85-88
3.	ELECTRICAL ROTATING EQUIPMENTS	89-97
4.	SWITCHES	98-103
5.	BREAKERS	104-105
6.	RELAYS	106-109
7.	CONTACTORS	110-113
8.	CONTROL PANELS	114-115
9.	GOVERNOR	116
10.	ELECTRICAL CIRCUITS	117-128
11.	TROUBLE SHOOTING (ELEC)	129-144
12.	COMPARISON	145-149

13. ACDCLOCOS (WDP1) 150-155
14. AUTOFLASHER LIGHT 156-161
15. TWIN BEAM HEAD LIGHT 162
16. SPEEDOMETERS 163-177
17. MCBG / MCS 178-197
18. RAKSHAKAVACH 198-199
19. WDG4/P4
    - Basic features 200-205
    - Engine starting system 206-207
    - Power Distribution System 208-210
    - Differences between G4p4 211-212

RUNNING

1. LOCOMOTIVE COMPARTMENTS 213-215
2. OPERATIN G 216-235
3. CUT OUT COCKS 236-238
4. SAFETY EQUIPMENTS 239-241
5. TEN TESTS 242-244
6. MULTIPLE UNIT 245-247
7. TRAIN HANDLING 248-267
8. FIRE FIGHTING 268-270
9. DO’s & DONTs 271-273
10. WDG4/P4
    - Locomotive compartments 274-294
    - Brake system WDG4P4 295-332
11. WDP1 333-336
12. ALCHOLISIM 337-338

Compiled by:



MECHANICAL
Sri. K.Fayazuddin,
DDI/Mech
DTTC/GUNTAKAL



ELECTRICAL
Sri. A.Prasadu,
DDI/Elec
DTTC/GUNTAKAL



RUNNING
Sri.M.M.Haq,
DDI/RNG
DTTC/GUNTAKAL



RUNNING
Sri. Syed Khaja Hussain
DDI/RNG
DTTC/GUNTAKAL



G. RANGAIAH
CHOS
DTTC/GUNTAKAL

MECHANICAL

CLASSIFICATION AND CONSTRUCTIONAL DETAILS OF INTERNAL COMBUSTION ENGINES

ENGINE:

It is an apparatus, which converts one form of energy into another form.

HEAT ENGINE:

It is an apparatus, which converts the chemical energy (heat energy) of fuel in to mechanical energy (rotational force). Heat engines are classified as follows:

1. External Combustion Engines.
2. Internal Combustion Engines

When the fuel is burning outside the engine cylinders is called external combustion engine. For example, steam locomotive. In steam locomotive, the coal (fuel) is burnt in boiler which convert water into steam pressure and this is applied on piston inside the cylinder to create reciprocating movement. This reciprocating movement is called LOCO MOTION. This loco motion is converted into rotational force.

When the fuel is burnt inside the engine cylinder is called INTERNAL COMBUSTION ENGINE. In this type of engine burning of fuel causes development of huge hot gases and there by exerted pressure on piston to thrust piston downwards. This reciprocating movement is converted into rotary motion by crankshaft.

Depending upon the ignition system used, the I C engines are further divided as:

1. Spark Ignition engines (SI ENGINES).
2. Compression Ignition engines (CI ENGINES).

The common differences between SI & CI engines are given in table:

Sl. No.	DESCRIPTION	S.I ENGINES	C.I ENGINES
1	Basic cycle	Constant Volume cycle	Constant pressure Cycle
2	Fuel	Gasoline/Petrol	Diesel oil
3	Induction of fuel	Air & fuel combined during suction stroke.	Direct fuel Injection at the end of comp. stroke

Sl. No.	DESCRIPTION	S.I ENGINES	C.I ENGINES
4	Load control	Throttle Controls quantity of mixture.	The quantity of fuel oil is regulated by FIP.
5	Ignition	Spark ignition	Compression ignition
6	Compression Ratio	6 to 10	12 to 20
7	Speed	High speed engine	Low speed engines.
8	Thermal efficiency	Low	High
9	Weight	Lighter	Heavier.

Depending upon the cyclic working of engine , I C engines are further classified into either 4-stroke cycle or 2-stroke cycle diesel engines. In a 4-stroke cycle diesel engine, the SUCTION, COMPRESSION, POWER and EXHAUST operations are carried out in 4 strokes of piston or 2 revolutions of crank shaft. In a 2-stroke cycle diesel engine, the same operations are carried out in 2- strokes of piston or one revolution of crank shaft.

The comparison of 2- stroke and 4-stroke cycle engines are given below:

Sl. No.	FOUR STROKE	TWO STROKE
01.	The cycle is completed in 4-strokes of piston or two revolution of crank shaft	The cycle is completed in 2-strokes of piston or ONE revolution of crank shaft
02.	Heavier fly wheel is needed	Lighter fly wheel is sufficient

03.	Power produced from same size of engine is less.	Power produced from same size of engine is high.
04.	Less cooling requirement.	Greater cooling requirement.
05.	Lower rate of wear & tear.	Higher rate of wear & tear.
06.	Valve lever mechanism is required for opening & closing of valves	Only exhaust valves require mechanism for closing of valves.
07.	Initial cost is more.	Initial cost is less.
08.	High thermal efficiency	Low thermal efficiency.
09.	Used where efficiency is more important.	Used where low cost, compact and light weight are important

Depending upon the number of cylinders, the I C engines are further divided as:

1. Single cylinder engine.
2. Multi cylinder engine.

Depending upon the placement of cylinders, the I C engines are divided as:

1. Horizontal inline cylinders engine .
2. Vertical inline cylinders engine.
3. V- type cylinders engine.
4. Star type cylinders engine.

Depending upon the Air intake to engine cylinders, the I C engines are divided as:

1. Naturally aspirated engines.
2. Super charged engines.

Depending upon the cooling system , the I C engines are divided as:

1. Air cooled engines
2. Water cooled engines.

Main components of an IC engines:-

1. Cylinder liner :

It is one of the most important part of the engine in which the piston moves to and fro in order to develop power . Generally the engine cylinder has to be with stand a high pressure and temperature, which is made of special alloys.

2. Cylinder head :

It is fitted on one end of the cylinder liner and acts as to close the cover cylinder bore. Generally the cylinder head contains inlet and exhaust valves for admitting fresh charge ,and exhausting the burnt gases.

3. Piston :

It is considered as the heart of an IC engine .whose main function is to transmit the force exerted by the burning of charge to the connecting rod.

4. Connecting rod :

It is a link between the piston and crank shaft whose main function is to transmit the force from the piston to the crank shaft. More ever it converts reciprocating motion of the piston in to circular motion of the crank shaft.

5. Crank shaft:

It is consider as the back bone of an IC engine whose main function is to convert the reciprocating motion of the piston in to the rotary motion with the help of connecting rod.

6. Crank case:

It is a cast iron case which holds the cylinder liner and crank shaft of an IC engine. It also serves as a sump for the lubricating oil .

WORKING OF 4 STROKE CYCLE DIESEL ENGINE:

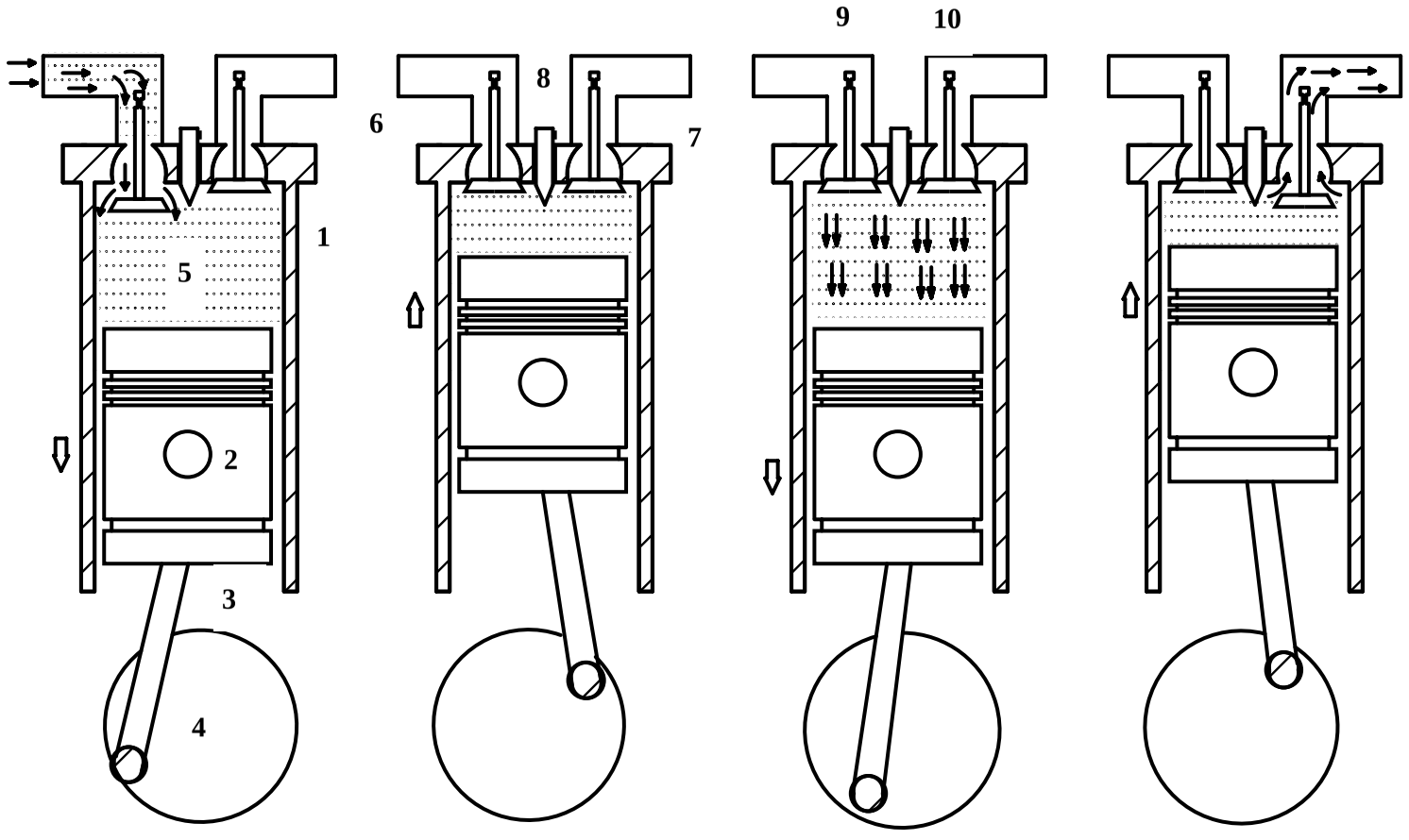
1. SUCTION STROKE: In this stroke the piston is moving from TDC to BDC. The inlet valve is kept open and air enters into the engine cylinder.

2. COMPRESSION STROKE: In this stroke both valves are kept closed. The trapped air in the cylinder getting compressed due to piston moving from BDC to TDC. Due to this the pressure and temperature of air are increased. As the piston reaches to TDC, the fuel is injected into the engine cylinder.

3. POWER STROKE: The burning of air / fuel mixture develops huge hot gases. This makes the piston to move from TDC to BDC and in turn crank shaft rotates on its own.

4. EXHAUST STROKE: In this stroke piston moves from BDC to TDC. The exhaust valve kept in open. The waste gases starts escaping from cylinder.

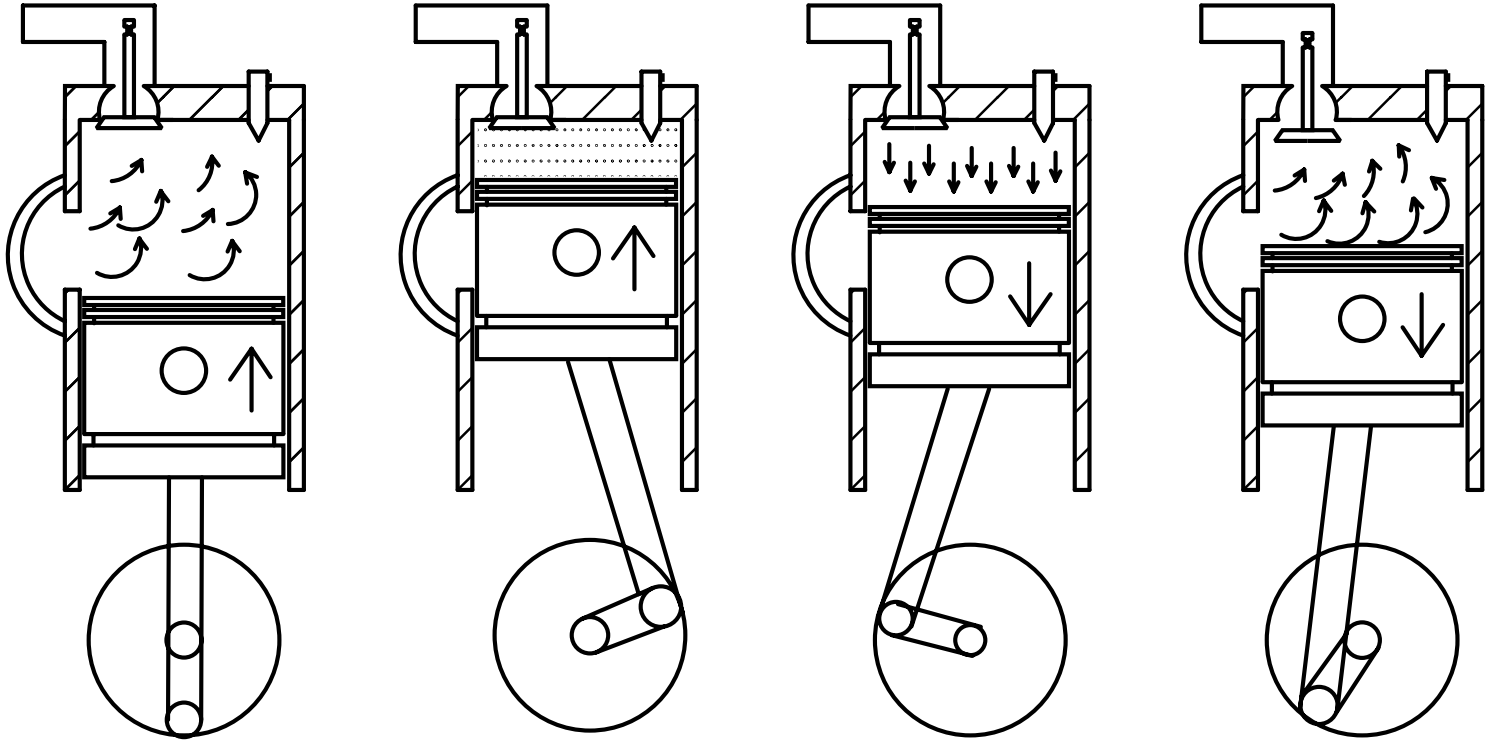
After completion of exhaust stroke, again the suction stroke takes place and cycle will repeat and engine kept in working. The engine in WDM2, YDM4/4A, WDM3A, WDP1 and WDG3A locos work in this principle.



FOUR STROKE CYCLE ENGINE WORKING PRINCIPLE

4-STROKE CYCLE ENGINE PARTS:

1. CYLINDER LINER
2. PISTON
3. CONNECTING ROD
4. CRANK SHAFT
5. COMBUSTION CHAMBER
6. INLET MANIFOLD
7. EXHAUST MANIFOLD
8. INJECTOR
9. INLET VALVE
10. EXHAUST VALVE



TWO STROKE CYCLE ENGINE WORKING PRINCIPLE

WORKING OF 2-STROKE CYCLE DIESEL ENGINE:

In this type of engine, two or more operations are being overlapped. Inlet valves are replaced by ports (a cut on cylinder liner). The opening and closing of port is regulated by piston movement itself.

INTAKE : Since the piston is away from the ports (at BDC) the out side air starts rushing into engine cylinder. This process continues till the piston obstructing the ports.

COMPRESSION: Once the piston obstructed ports further air entry is stopped and trapped air is getting compressed till the piston reaches to TDC.

POWER: Once the piston reaches TDC, fuel is injected into compressed air and oil is burnt. Due to this immediately piston starts moving down and in turn the crank shaft rotates on its own.

EXHAUST & SCAVENGING: As the piston starts moving from TDC to BDC at one time the piston is again away from ports. Due to this the out side air starts rushing in. Mean time the exhaust valve also kept open to vent out waste gases. This process of simultaneous entry of air venting of gases is called SCAVENGING.

After reaching of piston to BDC, it starts moving in up direction. The process of air entry continues up to piston obstructing ports. And again during same movement the compression of air also happens. In this each time piton moves from TDC to BDC with the POWER.

CLASSIFICATION OF DIESEL ENGINES IN VARIOUS LOCOMOTIVES:

In WDM2,2A,2B, WDM3A, WDG3A, WDP2 locos:

16-cylinder, V-type Inline, 4-stroke cycle, solid fuel injection system with separate FIP and Injector, forced feed lubrication, water cooled, turbo charged, variable speed, diesel engine.

In WDP1 locomotives:
12-cylinder, V-type Inline, 4-stroke cycle, solid fuel injection system with separate FIP and Injector, forced feed lubrication, water cooled, turbo charged, variable speed, diesel engine.

In WDG4 and WDP4 locos:
16-cylinder, V-type Inline, 2-stroke cycle, solid fuel injection system with unit injectors, forced feed lubrication, water cooled, turbo charged, variable speed, diesel engine.

In YDM4/4A, WDS6 locos:
6-cylinder, Vertical Inline, 4-stroke cycle, solid fuel injection system with separate FIP and Injector, forced feed lubrication, water cooled, turbo charged, variable speed, diesel engine.

DIESEL-ELECTRIC LOCOMOTIVE WORKING PRINCIPLE:

Transmission: The method of transferring power from one place to other place is called transmission system.
In Diesel transmission system there are three types:
1. Diesel- Mechanical transmission.
2. Diesel- Hydraulic transmission.
3. Diesel- Electric transmission.

In Diesel Mechanical transmission the power transferred is via clutch and gear box mechanism. e.g., trucks & buses.

In Diesel Hydraulic transmission the power is transferred via Torque converter/ fluid coupling. e.g., WDS4B and WDS 4D.

In Diesel- Electric transmission, the power developed in the engine is utilized to rotate armature in traction generator.

This produces electric power. The developed power is regulated in control gear equipment and supplied to traction motors. The traction motors will again produces mechanical power. The pinion of traction motor armature is connected to axle through bull gear. Due to this the axle starts revolving and loco moves due to combined effort of all Traction motors.

The Diesel- Electric transmission is again divided into 3 types:
1. DC/DC electric transmission: In this the generator is of DC type and traction motors also of DC series motors. E.g: YDM4/4A, WDM2, WDS6.

2. AC/DC electric transmission: In this the alternator is provided to produce AC current and traction motors are of DC series type. To convert the power from AC to DC a rectifier panel is provided.
E.g: WDM2 (AC/DC), WDM3A, WDG3A, WDP1 and WDP2.

3.AC/AC electric transmission: In this the alternator and AC induction motors are provided.
E.g: WDG4 and WDP4 locos.

WORKING OF FUEL OIL SYSTEM (16 Cyl BG LOCOMOTIVES)

Before cranking the diesel engine, for the purpose to create fuel oil pressure the following items to be put 'ON'.

1. Battery Knife switch provided in nose compartment,
2. MB1& MB2 breakers on control panel,
3. MFPB 1 & 2 breakers in both control stands
4. Fuel pump breaker (FPB) on control panel .

Then the battery current will go to the Fuel Pump Motor (FPM)located in Expresser Room and motor starts working. This fuel pump motor is connected to fuel booster pump ((FBP) through "love joy coupling".

As the fuel pump motor starts revolving , the pump will work and sucks the diesel oil from the tank . The drawn oil from the tank will pass through the fuel trap and fuel oil primary filter and get purified .Then it will enter in to the booster pump getting pressurized and delivered in to the discharge pipe line. At the out let of the pump, the relief valve is provided and it is set at 5 to 5.3 kg/cm^2 . Due to this if the discharge pressure is more than setting value, the excess oil will go back to the fuel tank duly protecting the booster pump . The normal path of the oil is from booster pump to secondary filter. After getting cleaned in the secondary filter , the oil will further goes to the engine right side fuel header pipe. From this header pipe line , the oil is fed to the right bank 8 (eight) cylinder locations Fuel injection pumps (FIP) through individual fuel jumper pipes. The same oil will go to the left side fuel header pipe through a flexible cross over pipe. Similar to the right bank here also the fuel oil is supplied to 8 FIPs through individual jumper pipes .

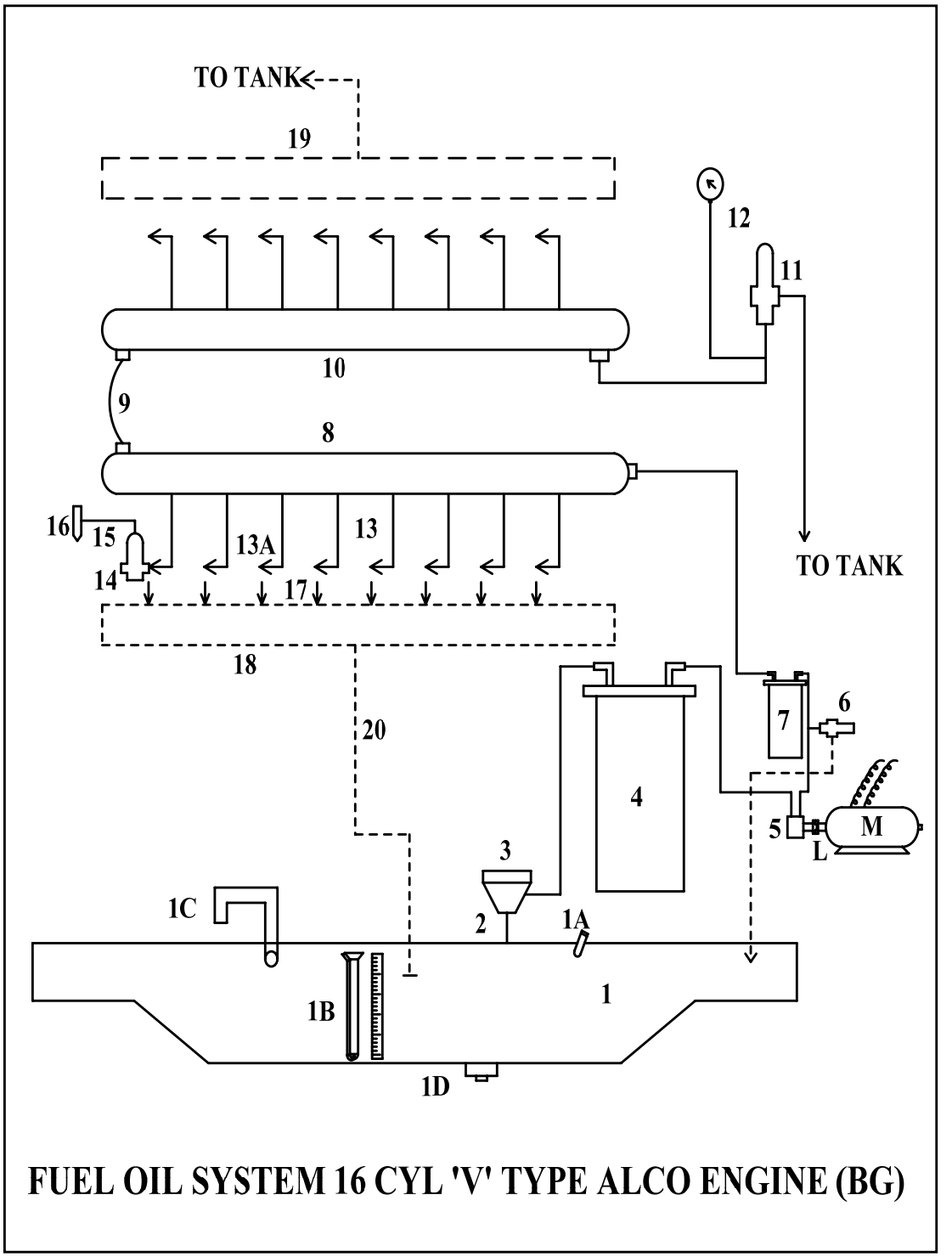
After filling of the right side and left side header pipes , through a flexible pipe , the oil is further touching to a regulating valve is set at 3.8 to 4.2 kg/cm^2. In case more pressure is developed (to maintain constant pressure) in the system, excess oil will return to the fuel tank by the operation of this regulating valve. At the bottom of this regulating valve , a small branch connection is taken to connect it to the fuel oil pressure gauge located in the drivers cab to indicate the fuel oil pressure in the system

When the engine is cranked each FIP will start working from cam & FIP support and further pressurizes (app. 4000 PSI) the fuel oil. This High Pressure Oil will discharge into a High Pressure pipe line (HP pipe), which is connected to Fuel Injector provided inside the cylinder head. The injector will discharge this oil in a fine atomized form into the combustion chamber. When this sprayed fuel oil mixed with already compressed air in the combustion chamber develops huge hot gases and produces power.

The unused / balance oil left behind in the injector will be collected back through individual leak-off pipes in to the leak off gallery or drain channel on the right and left bank will return back to the fuel tank.

FUEL OIL SYSTEM PARTS:

1. FUEL TANK
1A. FUEL FILLING CAP WITH STRAINER
1B. GLO ROD GAUGE WITH SCALE
1C. INDIRECT VENT PIPES
1D . DRAIN DUMMY
2. SUCTION PIPE
3. FUEL TRAP
4. FUEL OIL PRIMARY FILTER
5. FUEL BOOSTER PUMP
6. FUEL OIL RELIEF VALVE
7. FUEL OIL SECONDARY FILTER
8. RIGHT SIDE FUEL OIL HEADER
9. FLEXIBLE CROSS OVER PIPE
10. LEFT SIDE FUEL HEADER
11. FUEL OIL REGULATING VALVE
12. FOP GAUGE WITH PIPE LINE
13. FUEL JUMPER
13A. FUEL BANZO BOLT
14. FUEL INJECTION PUMP
15. FUEL OIL HIGH PRESSURE PIPE (HP PIPE)
16. FUEL INJECTOR
17. FUEL LEAK OFF PIPE
18. LEAK OFF GALLARY (DRAIN CHANNEL)(RIGHT)
19. LEAK OFF GALLARY (DRAIN CHANNEL)(LEFT)
20. RETURN PIPE TO TANK (FLEXIBLE)
L- LOVE JOY COUPLING
M- FUEL PUMP MOTOR (FPM)



FUEL OIL SYSTEM 16 CYL 'V' TYPE ALCO ENGINE (BG)

Sl. no	Name of the item	Location	Connected in between	Purpose/ function of the item
01.	Fuel tank	Underneath the chassis bet. Two trucks	---	To store the required fuel oil
01.a	Fuel filling plug with strainer	On both sides of the fuel tank	---	To charge fuel oil into the tank and mean time to avoid dirt to enter into the tank.
01.b	Fuel glo-rod gauge	On both sides of the fuel tank	---	To check fuel oil level in the tank.
01.c	Indirect vent pipe (s)	On top of the tank both sides (located in engine room power take-off end).	---	To have the atmospheric air contact with oil surface.
01.d	Drain dummy	At the bottom of tank	---	To drain the fuel from tank if required.
02.	Suction pipe	---	Between fuel tank and fuel booster pump	To supply oil from tank into the FBP
03.	Fuel trap	In engine room on right side.	Between fuel tank and fuel primary filter.	To arrest heavy particles in fuel such as paper, clothe and rubber pieces with the help of a mesh.
04.	Fuel primary filter	On engine block towards free end of the engine block.	Between fuel trap and FBP.	To clean the fuel oil from dust and dirt as well to arrest moisture/ water present in fuel oil using a paper type filter.
05.	Fuel booster pump	Expressor room	Between suction and discharge pipe lines.	To lift the fuel from tank on to the engine.

06.	Fuel oil relief valve	Engine room right side towards free end	On top of discharge pipe at the outlet of FBP.	To avoid over load on the pump and to avoid damage of pipe lines due to excess pressures by sending excess oil back to the fuel tank. (set at 5- 5.3 Kg/cm^2)
07.	Fuel secondary filter	On engine block towards free end of the engine block.	Between Booster pump and right side header pipe	To clean the fuel oil using a paper type filter from dust and dirt which is left by primary filter.
08.	Fuel right side header	Inside the engine block on right side.	---	To supply the fuel to right side FIPs.
09.	Flexible crossover pipe.	On the engine block towards power take-off end	Between right and left fuel headers.	To supply oil from right header into the left header.
10.	Fuel left side header	Inside the engine block on left side.	---	To supply the fuel to left side FIPs.
11.	Fuel oil regulating valve	Engine room left side towards free end	---	To keep oil inside both headers with required pressure by sending excess oil back to the tank (opens at 3.8- 4.2 kg/cm^2)
12.	FOP gauge with gauge pipe line.	In side the Dr's cab.	Connected from bottom of the regulating valve.	To indicate fuel oil pressure in the header pipe lines.
13.	Fuel Jumper pipe (s)	Engine room	Between fuel header and each Fuel Injection Pump	To supply oil from header into the FIP through Fuel Banjo bolt (13A).
14.	Fuel Injection Pump (FIP)	Engine room	---	To supply oil to the engine at the right time, right quantity and at the right pressure by operating through fuel cam.
15.	Fuel oil High Pressure Pipe line (s) (HP pipe)	Engine room	Between FIP and Fuel injector	To supply oil from FIP into the injector
16.	Fuel injector (s)	Inside the cylinder head	---	To inject oil into cylinder in a fine spray form.

WORKING OF LUBE OIL SYSTEM

NECESSITY OF LUBRICATION:

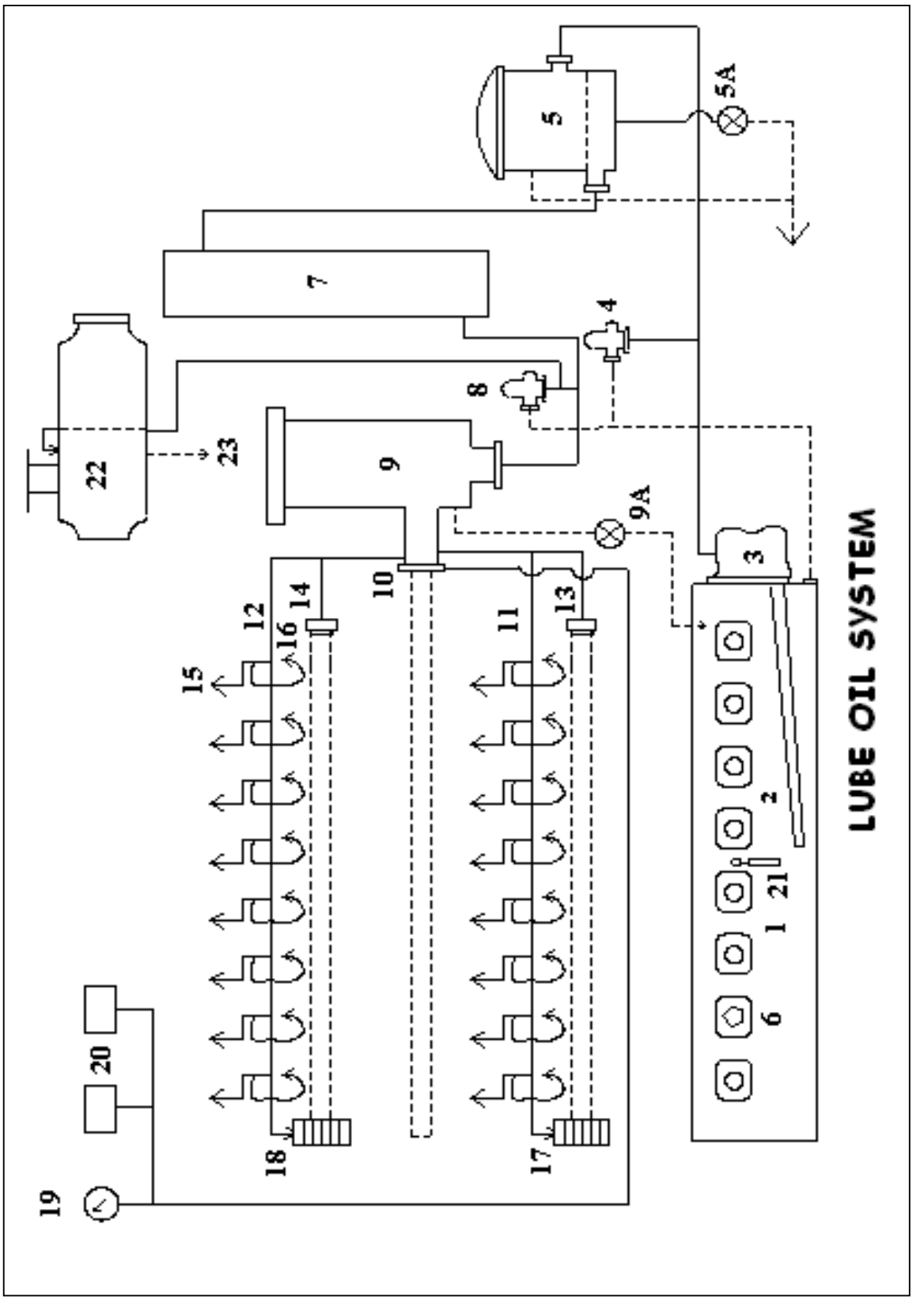
1. To reduce the friction between moving parts.
2. To reduce the wear & tear of the moving parts.

The lube oil system in the loco is of forced feed system i.e., the oil is supplied under pressure. For this purpose a good amount of lube oil is stored in sump. The capacity of the sump is varied for different locos and it is as follows:

	Type of Loco	Capacity	Dip stick reading (H-L)
1.	WDM2 loco	910 Ltrs.	400 Ltrs.
2.	WDM3A LOCO	1110 Ltrs.	600 Ltrs.
3.	WDG3A loco	1025 Ltrs.	600 Ltrs.
4.	WDP1 loco	760 Ltrs.	320 Ltrs.

A lube oil pump is provided on free end of the engine towards right side. It is driven by a gear on the crank shaft extension shaft. The pump is of gear type (positive displacement type). The pump sucks the oil from sump through suction pipe which will be delivered into the discharge pipe . On this pipe line a relief valve is provided and is set at 130 PSI (9kg/cm^2). In the event of excess pressure, this valve will open and sends the excess pressure back to the lube oil sump. Through discharge pipe line the oil will go to the lube oil filter drum located in the radiator compartment. This filter drum is having 8 paper type filters. Lube oil while crossing through the filter drum will get cleaned. This oil is further allowed to go to lube oil cooler which is also located in radiator compartment. Lube oil entering into the cooler will get cooled due to the indirect contact with the coolant water. This helps in maintaining lube oil viscosity within the limits. The oil will further enter into the lube oil strainer. A branch pipe is drawn between the cooler and strainer to connect it to the lube oil regulating valve which is set at 110 PSI (7.7 kg/cm^2). This valve will maintain the system pressure by sending the excess pressure back to the lube oil sump in case it is exceeded. In the lube oil strainer the oil is allowed to get down through a fine micronic mesh and thus cleaning the oil. Further the oil is allowed into the lube oil main header which is located at left side of the engine base.

From the main header, the oil which is entering into the main header pipe will go to the main bearings through 'S' type jumper pipes. After lubricating the main bearings this oil will find its passage to connecting rod big end bearings through drilled passages in crank shaft. From inside of the connecting rod, the oil will further go to the small end of connecting rod to lubricate piston pin bearing. From here the oil will find its passage into the piston crown. After absorbing temperature from crown it will try to drop back into the sump. While dropping, this oil will splash back and fall on the cylinder liner walls to lubricate between liner and piston rings.


LUBE OIL SYSTEM
1
2
3
4
5
5A
6
7
8
9
9A
10
11
12
13
14
15
16
17
18
19
20
21
22
23

LUBE OIL SYSTEM

1. LUBE OIL SUMP
2. SUCTION PIPE
3. LUBE OIL PUMP
4. RELIEF VALVE
5. FILTER DRUM

5.A. DRAIN COCK FOR FILTER DRUM

6. C.C EXPLOSION DOOR (SPRING LOADED)
7. LUBE OIL COOLER
8. REGULATING VALVE
9. LUBE OIL STRAINER

9A. DRAIN COCK FOR STRAINER

10. CONNECTION TO LUBE OIL MAIN HEADER PIPE
11. LUBE OIL AUXILIARY HEADER PIPE (RIGHT)
12. LUBE OIL AUXILIARY HEADER PIPE (LEFT)
13. LUBE OIL CONNECTION TO OSTA & R/S CAM SHAFT BEARINGS
14. LUBE OIL CONNECTION TO L/S CAM SHAFT BEARINGS
15. CONNECTION TO VALVE LEVER MECHANISM
16. CONNECTION TO FIP SUPPORT
17. SPRAY NOZZLE PIPE TO CAM GEAR (RIGHT)
18. SPRAY NOZZLE PIPE TO CAM GEAR (LEFT)
19. LUBE OIL PRESSURE GAUGE
20. CONNECTION TO SAFETY DEVICE OPS1&OPS2 OR W.W.GOVERNOR for operation of LLOP
21. LUBE OIL DIP-STICK GAUGE
22. TURBO SUPER CHARGER
23. LUBE OIL DRAIN PIPE FROM TURBO TO SUMP (FLEXIBLE)

From the main header inlet connection one small branch pipe is taken to connect it to the lube oil pressure gauge and to the safety device (OPS/ LLOB). There are two branch connections from main header inlet- one is leading to right bank and other to left bank. From the right branch one connection is given to right side auxiliary header pipe mounted on top of the engine block. This aux. header will supply oil to valve lever mechanisms on top of cylinder heads and to FIP support mechanisms and also to right side cam gear through spray nozzle pipe. Before aux. header connection, one more connection is taken to supply oil to OSTA and right side cam shaft bearings. Similar connections were given on left side of engine also to supply oil to valve lever mechanisms and FIP supports and L/side cam gear as well as to left cam shaft bearings. From the bottom of the regulating valve, a flexible pipe connection is taken to supply the oil to turbo super charger (TSC). After lubricating the turbo, the oil is drained back to the sump through the flexible pipe. All the oil supplied to different parts will reach back to sump by gravity and ready for re-circulation. To protect the engine from low lube oil pressure damages, the safety device (in GE governor locomotives , OPS1 & OPS2- set at 1.6/1.3 Kg/cm^2 and 3.5/3.2 kg/cm^2 respectively / in WW governor locomotives LLOP set at 1.3kg/cm^2 in idle and 3.5Kg/cm^2 in 8th notch, depends upon the notch working) will come in to operation and makes engine to shut down.

NOTE: The drain cocks provided by the side of the filter drum and strainer unit should always be kept in close and sealed with sealing wire.

LUBRICANTS ARE USED IN DIFFERENT PLACES OF THE LOCOMOTIVE:

1. Engine sump
2. Expressor or compressor
3. Right angle gear box.
4. Air maize bath filter
5. Generator gear case
6. GD80 D filter
7. GD80 E filter
8. Centre pivot & Side bearers
9. Nose caps
10. Governor
11. RTTM blower
12. Universal shaft.
13. Buffers
14. Axle boxes
15. Fast coupling
16. Gear case.

REASONS FOR CONTAMINATIONS:

1. Water contaminating with lube oil - reasons may be cylinder liner crack or engine block may be crack.
2. Lube oil contaminating with water – lube oil cooler tubes may be damage.
3. Lube oil contaminating with fuel – cylinder head may be crack.
4. Fuel oil contaminating with lube oil – reasons may be injector dribbling or fuel drain channel may be crack.
5. Water contamination with fuel - reasons may be fuel filling cap not provided properly during raining or cylinder head sleeve may be crack.

SL.NO	NAME OF THE ITEM	LOCATION	CONNECTED IN BETWEEN	PURPOSE/ FUNCTION OF THE ITEM
1.	SUMP	Crank case	---	To store the required lube oil.
2.	Suction pipe	Inside the sump	Sump and lube oil pump	To supply lube oil from sump into the pump.
3.	Lube oil pump	Engine free end towards right side	---	To circulate lube oil in the system by rotating with engine crank shaft.
4.	Relief valve, lube oil	Expressor room on loco left side.	Provided on discharge pipe just at the outlet of pump.	To relieve the overload on lube oil pump and avoid bursting of discharge pipe lines by releasing excess pressure back to the sump. (set at 130 PSI)
5.	Lube oil filter drum	Radiator room	Pump and lube oil cooler	To filter the lube oil with the help of 08 paper type filter elements.
6.	Drain cock, filter drum	At the bottom of filter drum.	---	To drain the lube oil from tank during filter drum attention. (normally to be kept closed and sealed)
7.	Lube oil cooler	Radiator room	Filter drum and strainer	To cool the lube oil by indirect contact with coolant water.(to improve/ regain viscosity of oil)
8.	Lube oil regulating valve	Expressor room on loco left side.	Provided on the pipe line between cooler and strainer	To regulate the lube oil pressure going into strainer by sending excess pressure back into the sump.(set at 110 PSI)

SL.NO	NAME OF THE ITEM	LOCATION	CONNECTED IN BETWEEN	PURPOSE/ FUNCTION OF THE ITEM
9.	Lube oil strainer	Inside of E/ room on left side towards free end.	---	To clean the oil at the second stage by using a metallic mesh.
10.	Drain cock , strainer	Bottom of strainer	---	To drain the lube oil during strainer attention. (normally closed & sealed)
11.	Lube oil main header pipe	In side the sump.	---	To supply lube oil to the main bearings, Con. Rod bearings, liners and piston crown.
12.	Lube oil auxiliary header pipe(s)	On top of the engine block (R&L)	---	To supply lube oil to valve lever mechanism(s), FIP support(s) and to cam gears (R & L).
13.	L/Oil connection to OSTA & right side cam shaft bearings	---	---	To supply lube oil to OSTA & right side cam bearings
14.	L/Oil connection to left side cam shaft bearings			To supply lube oil to left side cam shaft bearings.
15.	Connection to valve lever mechanism	---	---	To supply lube oil to valve lever mechanism on top of cylinder heads.
16.	Connection to FIP support mechanism	---	---	To supply lube oil to FIP support mechanism.
17.	Spray nozzle pipe to cam gears (R&L)	---	---	To force the lube oil on to cam gears.
18.	Lube Oil Pressure gauge with gauge pipe line	DR's cab.	---	To indicate the lube oil pressure at the main header pipe inlet.

SL.NO	NAME OF THE ITEM	LOCATION	CONNECTED IN BETWEEN	PURPOSE/ FUNCTION OF THE ITEM
19.	Oil Pressure Switch (OPS)	DR's cab	---	To protect the engine from low lube oil damages. (set at 1.6/ 1.3 kg/cm2)
20.	Turbo lube oil Drain pipe (flexible)	Engine left side.	Turbo & engine sump.	To drain out lube oil from turbo to the sump.
21.	Spring loaded explosion door	On both sides of engine sump.	---	To protect the engine block from excessive pressure in the sump.
22.	Lube oil dipstick gauge	On right sight of sump.	---	To check the lube oil level in sump.

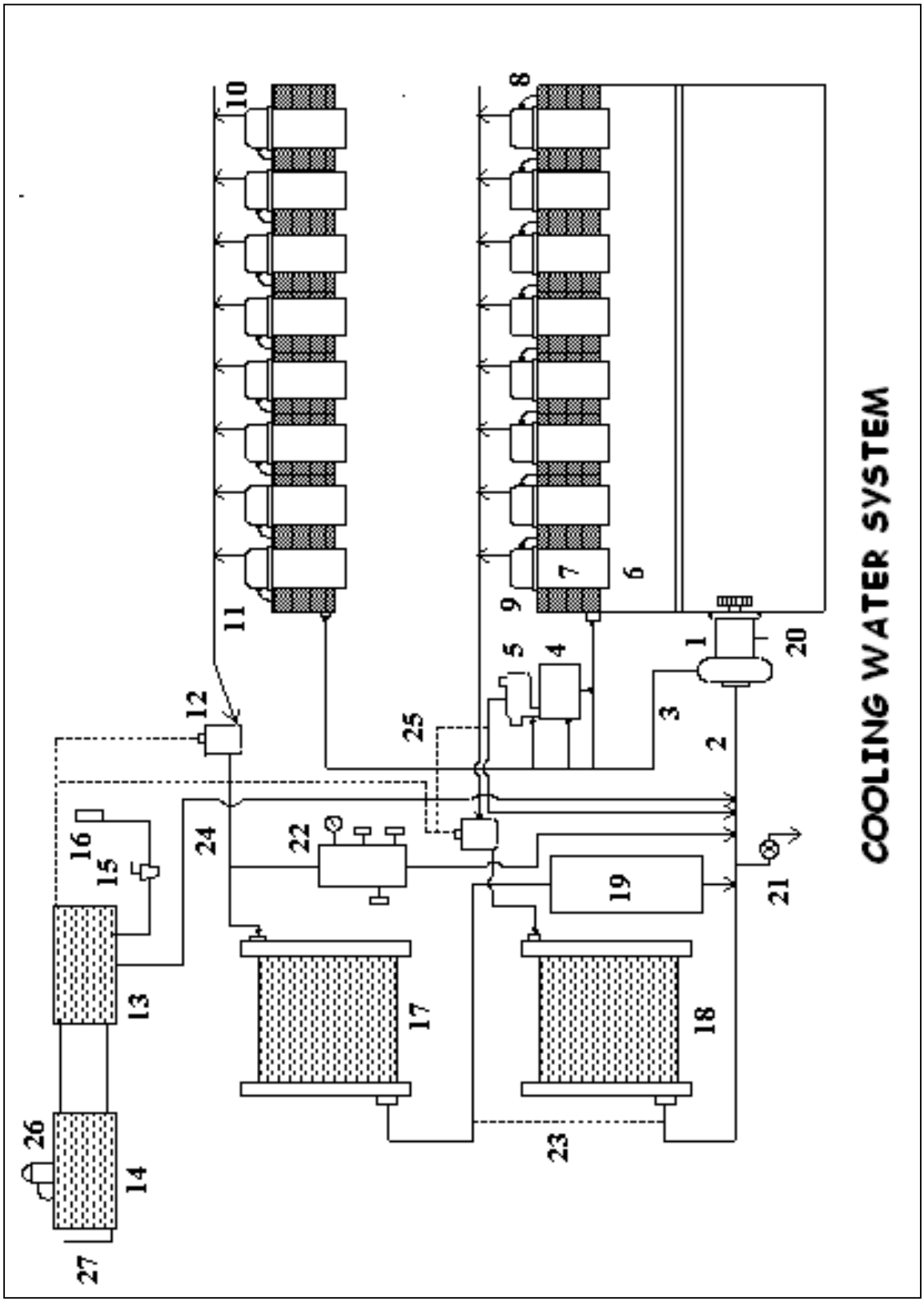
COOLING WATER SYSTEM IN LOCOMOTIVES

To produce more power from the engine, it is necessary to burn more fuel in the engine cylinders. Due to this the increased temperature will cause more heating of surrounding components. To control this and also to keep lube oil viscosity within the limits a cooling water system is incorporated. Here in cooling water system, the following things are happening- One the cooling of engine components using coolant water and the other the cooling of coolant water itself in radiators for re-circulation. For the circulation of water in system, a centrifugal type water pump is provided at the free end of the engine block. To achieve perfect cooling by the cooling water, the water used is either distilled or de-mineralized water further treated with chemicals known as Indion –1344 (Boron nitrite). With the adding of these chemicals the color of water will change to pink. The advantages behind this treatment is as follows:

a) Treated water avoids corrosion on ferrous metals.
b) It dissolves all water salts avoiding scaling in cooling water system.
c) It protects the flowing water from foaming, which may lead to air locks.
c) Boiling point of water is increased to minimize evaporating and consumption of water.
d) Leakage in the cooling water system is easily noticed as color marks (scars) noticed on leaking sources and also this chemical arrest minor leakages by forming powder deposits at leaking joints.

WORKING OF COOLING WATER SYSTEM IN BG LOCOMOTIVES:

At the engine free end towards left side a centrifugal water pump is provided to circulate water in system. The drive for the pump is from crank shaft extension shaft gear. Water pump will suck the cooled water coming from both radiators through suction pipe and discharges it into the system through discharge piping. The water coming from pump is mainly divided into two branch pipes- one for engine left bank and the other for right bank of the engine. From the right bank branch pipe line one flexible pipe is connected to supply water to turbo super charger(TSC). Here after cooling turbo parts the water is allowed directly to go back to suction side of pump. Further for cooling the turbo charged air (booster air) in after cooler also the coolant water is utilized. For this purpose, in case normal WDM2 locos, a branch connection is taken from left bank piping. After cooling the air in after cooler this water will join into the left bank. Where as in case of new locos or modified locos, the inlet and outlet connections for after cooler will be on suction pipe of water pump itself. On engine left bank there are 8 cylinders in a row inserted inside the engine block. The water is allowed to circulate inside the engine block around these cylinder liners (called water jackets).


COOLING WATER SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27

COOLING WATER SYSTEM

1. WATER CIRCULATING PUMP (CENTRIFUGAL)
2. SUCTION PIPE
3. DELIVERY PIPE
4. AFTER COOLER
5. TURBO
6. ENGINE BLOCK
7. CYLINDER LINER
8. WATER JUMPER
9. CYLINDER HEAD
10. WATER RISER PIPE
11. WATER RETURN HEADER (R&L)
12. BUBBLE COLLECTOR (R&L)
13. MAIN WATER EXPANSION TANK (No.1 TANK)
14. AUX. WATER EXPANSION TANK (No.2 TANK)
15. COC FOR LWS
16. LOW WATER SWITCH (LWS) FLOAT CHAMBER
17. LOCO LEFT RADIATOR
18. LOCO RIGHT RADIATOR
19. LUBE OIL COOLER
20. WATER PUMP TELL-TALE PIPE
21. DRAIN COCK
22. WATER TEMP. COLUMN WITH TS1, TS2, ETS & W/TEMP. GAUGE
23. RADIATOR WATER OUTLET EQUALISING PIPE
24. WATER MAKE UP PIPE LINE
25. VENT PIPES (FLEXIBLE)
26. PRESSURE CAP ASSEMBLY
27. WATER LEVEL GLO-ROD GAUGE

After cooling of engine block left portion and cylinder liners on left bank the water is further flowing into cylinder heads through individual water jumper pipes. After cooling the cylinder heads the hot water is allowed to rise in water riser pipes and collected into the left side water return header pipe. This very hot water while passing through water return header will cross through a bubble collector located on this piping. Here the bubbles/steam/hot gases available in water will be separated and vent out to expansion tanks through a flexible vent pipe. After this the water will pass into loco right side radiators. Here the water will cool due to indirect contact with atmospheric air while passing through several horizontal tubes. Then this water will be collected in to the suction pipe. The water entered into the engine right bank will cool the right side engine block, 8 cylinder liners and 8 cylinder heads. Then this water is collected into right side water return header pipe through individual water riser pipes. On this right side water return pipe one more bubble collector is provided to separate bubbles from the hot water. This hot water before going to cool in loco left radiators will touch to water temperature column pipe provided in expressor room. On this column Temperature switches- TS1, TS2 & ETS and also one water temperature gauge. The TS1 set at 68 Deg. C and TS2 set at 74 Deg. C will help in operation of radiator fan through R1 & R2 contactors. The ETS which is set at 90 Deg. C will act as a safety device by giving Hot Engine alarm indication. Due to this safety device operation there will be no effect on engine RPM. After cooling of the water in loco left radiators, it is allowed to pass in lube oil cooler unit. Then this water will find its passage to suction side of water pump. To compensate the loss of water in system either due to evaporation or due to minor leakages, there is a stored water in water expansion tanks. These tanks are mounted in radiator room hood. The tank available towards expressor room is called main expansion or No.1 tank. And the other tank towards long hood side is called auxiliary or No.2 tank. Both the tank levels are equalized with two equalizing pipes to maintain same levels in tanks. From the main expansion tank one make-up pipe line is connected to suction pipe. From this pipe line water is constantly added into system to avoid air lock. The same expansion tanks will have all the vent pipe connections from different points (bubble collectors from right & left bank and turbo outlet as well from after cooler outlet & radiator inlet pipes) to collect steam or hot gases. To protect the system from low water damages, a safety device is provided on main water expansion tank called Low Water Switch (LWS). A small pipe line is connected from main tank to LWS float chamber through a COC. As far as water level is maintained in tank to at least 1" level above from bottom of tank the LWS float ball will lift and make the micro switch in N/C condition. If the water in tank is reduced or when LWS COC is closed (for testing) then this float chamber will become empty and float will drop. Due to this the micro switch connection will reverse and makes the engine to shut down with Hot Engine Alarm indication.

NOTE: LWS COC is supposed to remain in OPEN position.

A water level Glo-Rod gauge is provided on auxiliary expansion tank to check the water level. On the same expansion tank top, a pressure cap assembly is provided. It should be ensured that the cap is properly seated on expansion tank to avoid water siphoning out.

NOTE : Do Not Dummy the Flexible Vent Pipes.

WATER PUMP TELL-TALE PIPE:

To indicate the failure of water pump water seal or oil seal a tell-tale pipe is provided at the bottom of water pump housing. In case water seal is damaged, water will leak out or oil seal is failed oil will leak out. In case leakage is noticed, check the leakage rate and act accordingly.

Similarly there is a tell-tale pipe at the bottom of AFTER COOLER also to indicate the failure of after cooler core. Same action is to be taken if water is leaking from this tell-tale pipe.

ENGINE AIR INTAKE SYSTEM or CHARGE AIR SYSTEM

NECESSITY OF SUPER CHARGING:

To obtain more Horse Power from the engine it is necessary to burn more fuel inside the engine cylinder(s). For complete burning of this fuel and to give maximum heat energy, presence of more amount of air is required. But by the action of piston inside the cylinder during suction stroke always a constant volume of air only can be sucked which depends on cylinder sizes. To put in more amount of air into it, the atmospheric air is pre- pressurized outside the cylinder(s) by the use of a rotor driven blower (rotary compressor). This rotor works with the exhaust gases coming from engine. The process of sending this pre-pressurized air to the engine is called super charging and the machine used for this purpose is called Turbo Super Charger(TSC).
Turbo Super Charger(TSC): This machine consisting of a turbine rotor unit comprising of a turbine rotor with blades, and a blower (rotary compressor) which are connected with a rotor shaft.

WORKING OF ENGINE AIR INTAKE SYSTEM :

At the engine free end, a Turbo super charger is mounted on the top of after cooler housing -cum- TSC support. The exhaust manifold pipe of engine is directly connected to TSC. All the exhaust gases collected from each cylinder exhaust elbow, will flow in this pipe and pass in gas inlet casing. Through fixed nozzle ring the gases strikes turbine rotor with blades inside the turbine casing. This makes the rotor to revolve, and then the gases will escape through exhaust chimney provided on turbine casing. The rotation of turbine rotor will cause blower also to rotate which is mounted on other end of rotor shaft. The shaft is supported with two bearings inside the intermediate casing. The blower is covered in blower casing and its rotation will suck the atmospheric air through car body filters (CBF) and engine air intake filters (Air maze oil bath filters or cyclonic air filters). Here the air is cleaned either by oil bath in case of oil bath filters or inertia in case of cyclonic air filters. Continuous rotation of blower will compress the atmospheric air. Due to the compression the temperature of air also will increase and makes air density to reduce. To increase density of this turbo charged air by cooling it, it is discharged into the after cooler unit. Here the air is cooled due to indirect contact with coolant water which is passing in after cooler core. The cooled compressed air is called BOOSTER AIR is now further discharged into air inlet manifold or 'V' channel which is located inside the engine block. From here there are 16 air inlet elbows which are connected to each cylinder head towards inlet valves. As per the cyclic operation, the inlet valves will open and booster air will rush into engine cylinder. After completion of compression and power strokes in the engine cylinder(s) the exhaust gases will be sent out and collected in exhaust manifold. From exhaust manifold again gases will enter TSC and revolves turbine rotor and finds path into atmosphere. On the other side, the blower will suck in more and more air due to increased speed and develops more Booster Air for the engine.

This Booster air will develop from 4th/ 5th notch RPM on load (train working) only. At 8th notch full load the developed hot gases will rotate turbine rotor at 18,000 to 21,000 RPM depends upon the TSC design and develops BAP up to 1.6 to 2.4 Kg/cm^2 according TSC. To indicate the BAP there is a gauge pipe connection on V channel and gauge is provided in Drivers cab. In case WW governor locos, a branch connection is taken to WW governor also to operate over riding function in governor.

CYCLONIC AIR FILTERS

These are fitted in new locos, in place of air maze oil bath filters. Where ever these filters are available, make sure that DUST EXHAUSTER MOTORS are working.

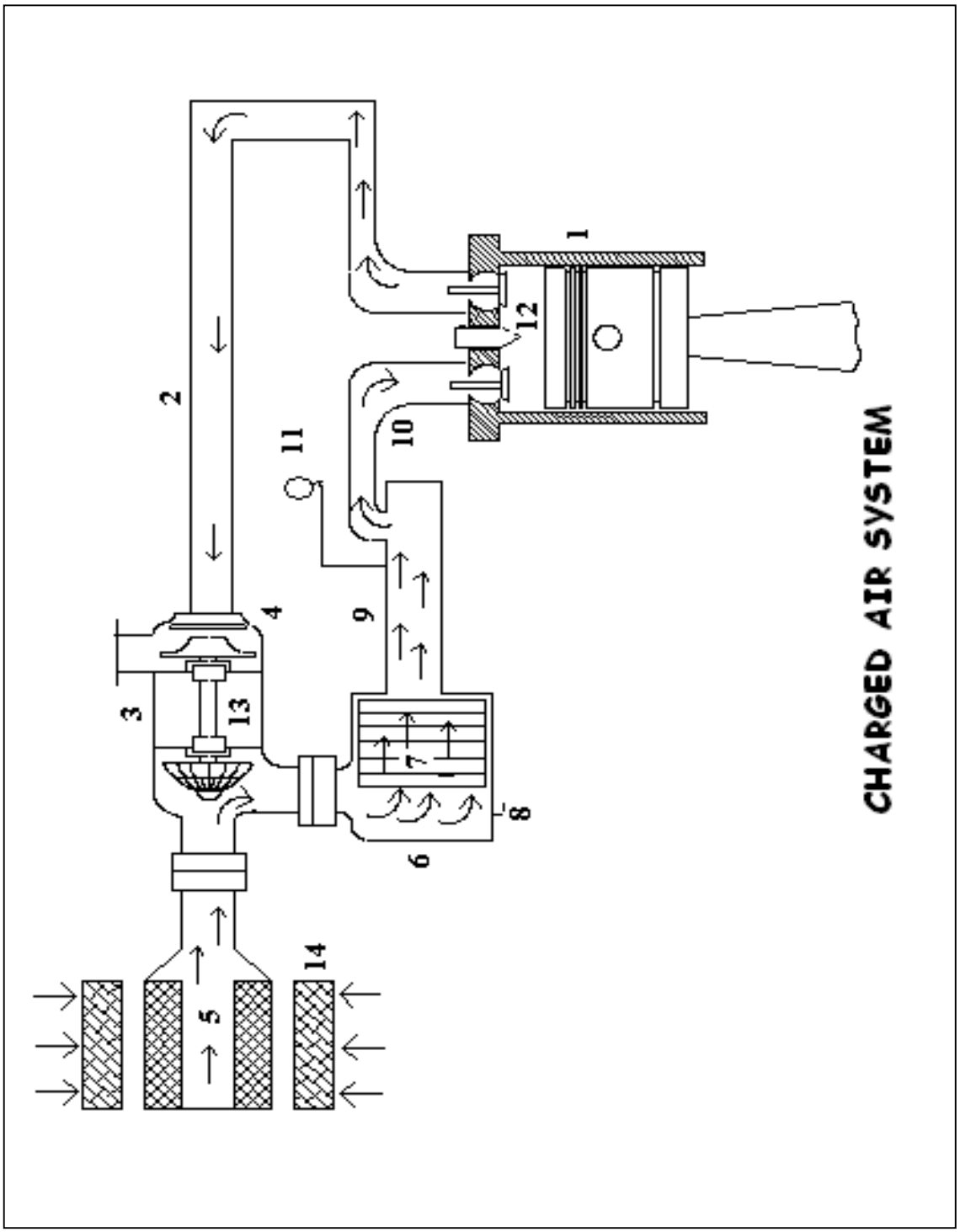
TURBO RUNDOWN (TRD) TIME TEST

This test is conducted on Diesel Electric locomotives, to understand the functioning of turbo super charger in case of BAP not building up/ hauling power poor/ lube oil throw from turbo chimney or unusual sound from turbo unit.

In this test, the time taken by the turbine rotor to STOP on its OWN is measured after complete stopping of Engine crank shaft.

PROCEDURE FOR CONDUCTING TRD TEST:

1. Before going to conduct TRD test, SAFETY should be observed:
   a) there should not be OHE (AC traction) lines in section.
   b) the loco/train should be secured properly as per the procedure.
2. Keep GFCO switch in OFF, 'RH' in neutral.
3. Keep the engine in IDLE, observe engine. It should be normal.
4. Observe for any leakages of exhaust gases.
5. After that keep the engine in stipulated notch depending on type of turbo in the loco.
6. Shutdown the engine at that notch using MUSD switch.
7. Wait for engine crank shaft to STOP by observing fast coupling.
8. Then observe the turbine rotor rotation from exhaust chimney for its STOP.
9. Note down the time taken by turbine rotor to stop after engine crank shaft stopping. It should be within the limits as prescribed for that particular type of turbo.
10. If it is less than the prescribed values, then fail the locomotive by giving message with the prevailed trouble in turbo.


CHARGED AIR SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
13
14

CHARGE AIR SYSTEM

1. ENGINE CYLINDER
2. EXHAUST MANIFOLD PIPE
3. TURBO CHARGER
4. FIXED NOZZLE RING
5. AIR MAZE OIL BATH FILTERS
6. AFTER COOLER HOUSING
7. AFTER COOLER CORE
8. AFTER COOLER TELL-TALE PIPE
9. AIR INLET MANIFOLD ('V' CHANNEL)
10. AIR INLET ELBOW (16 Nos.)
11. BAP GAUGE
12. COMBUSTION CHAMBER
13. TURBINE ROTOR SHAFT WITH ROTOR & BLOWER
14. CAR BODY FILTERS (CBF)

TURBO RUNDOWN TEST FOR DIFFERENT TURBO SUPER CHARGERS

Sl. No.	TYPE OF TURBO	LOCOS ON WHICH PROVIDED	PRELIMINARY CONDITIONS FOR TRD TEST	NOTCH AT WHICH ENGINE TO BE SHUTDOWN	TRD TIME IN SEC.	REMARKS
01.	720 A/ ALCO	WDM2	1. No OHE lines 2. Loco/train to be secured as per procedure. 3. Engine condition Normal. 4. No exhaust manifold leakages. 5. No BAP leakages 6. Radiator fan should be in stopped condition. 7. Turbine rotor in rotation	4TH notch	90-180	Observe Turbine rotation through exhaust chimney.
02.	NAPIER 2600 or 3100 HP	WDM2 (mod.) WDM3A WDG3A WDP1 WDP2		IDLE	20-65	
03.	ABB 2600 or 3100 HP	-do-		4TH notch	120-200	
04.	GE	-do-		-------	------	No TRD test specified
05.	350C	YDM4 &4A		8TH NOTCH	90-180	Observe blower from air duct window.

EXPRESSOR

The combined unit of exhausters and compressor is called the expressor unit. This unit runs through engine crank shaft which is connected to it with a fast coupling. The expressor of 6CD-3UC model consists of 6 cylinders out of which 3 cylinders will work as exhauster cylinders and 3 cylinders will work as compressor cylinders (6 CD-4UC type expressor will have 4 exhausters & 2 compressors). The large compressor cylinders are Low pressure cylinders. And small compressor Cylinder. is High pressure cylinder.

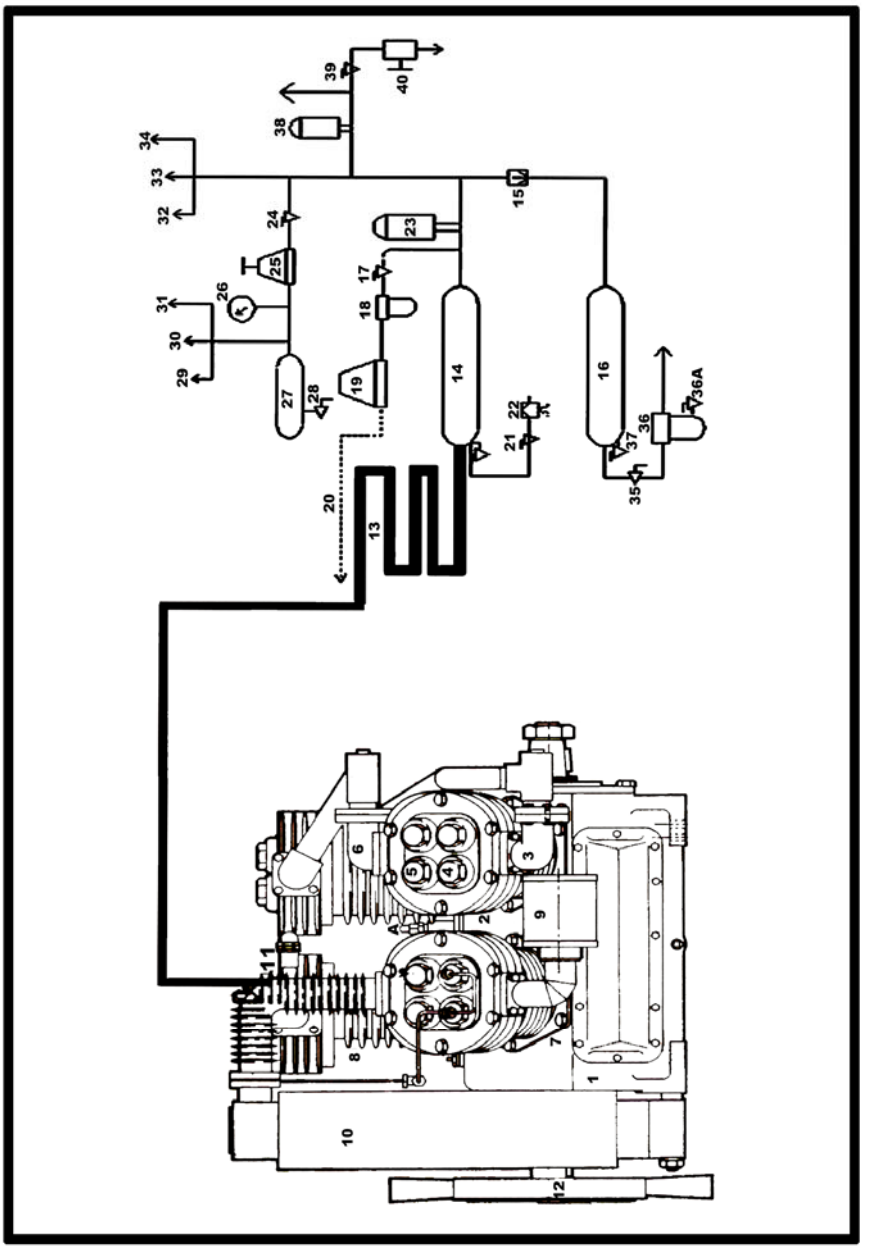
IMPORTANT COMPONENTS IN EXPRESSOR: (6CD-3UC)

1. EXPRESSOR CRANK CASE
2. EXHAUSTER CYLINDERS (3)
3. LP COMPRESSOR CYL.(2)
4. HP COMPRESSOR CYL.(1)
5. CYLINDER HEADS
6. INLET MANIFOLD PIPE
7. DISCHARGE MANIFOLD PIPE
8. AIR INTAKE FILTER
9. INTER COOLER;
10. I/COOLER SAFETY VALVE
11. INTER COOLER FAN
12. PISTONS (EXH., LP & HP)
13. CONNECTING RODS
14. INLET VALVES(EXH., LP & HP)
15. DISCHARGE VALVES
16. UNLOADER VALVES(ON THE INLET VALVES OF COMPRESSOR LP & HP)
17. BRASS SPINDLE UNIT
18. CRANK CASE BREATHER VALVE

WORKING OF EXHAUSTERS:

During the running of exhauster cylinders, all the 3 cylinders will suck-in air from vacuum train pipe and simply discharges this air into atmosphere so as to create vacuum in VTP.

EXPRESSOR AND AIR SYSTEM



1. EXPRESSOR CRANK CASE
2. EXHAUSTER CYLINDERS (3)
3. INLET MANIFOLD
4. INLET VALVES
5. DISCHARGE VALVES
6. DISCHARGE MANIFOLD
7. LP COMPRESSOR CYLINDER
8. HP COMPRESSOR CYLINDER
9. AIR INTAKE FILTER
10. INTER COOLER
11. INTER COOLER SAFETY VALVE
12. INTER COOLER FAN

A. CRANK CASE BREATHER VALVE CUM OIL FILL

13. COOLING COIL PIPES (L&R)
14. MAIN AIR RESERVOIR 1 (MR1)
15. NON-RETURN VALVE
16. MAIN AIR RESERVOIR No.2 (MR2)
17. AC GOVERNOR COC
18. AIR FILTER BOWL
19. AIR COMPRESSOR GOVERNOR
20. FLEXIBLE PIPE CONNECTED TO UNLOADER VALVES
21. COC FOR ABD VALVE
22. AUTO DRAIN VALVE (ABD VALVE)
23. MR SAFETY VALVE
24. COC FOR N1 REDUCING VALVE
25. N1 REDUCING VALVE
26. CONTROL AIR PR. GAUGE
27. CONT. AIR RESERVOIR
28. DRAIN COCK FOR C.A.R
29. CONNECTION TO P/CONT
30. CONNECTION TO BKT
31. CONNECTION TO REV
32. COONECTION TO HORNS
33. CONNECTION TO WIPERS
34. CONNECTION TO SANDERS
35. BRAKE SYSTEM COC
36. 'J' FILTER , A- DRAIN COCK
37. MR DRAIN COCK
38. DUPLEX CHECK VALVE
39. 1" FP COC
40. FEED VALVE

WORKING OF COMPRESSORS:

During the running of compressor cylinders the LP cylinder draws the atmospheric air through air intake filter. The discharge of the LP cylinder is sent into an INTER COOLER. Here the air is getting cooled with the help of inter cooler fan mounted on expressor crank shaft. Further this air is sent into HP comp. cylinder. Due to the working of HP cylinder., further the air pressure is increased and discharged into MR1 air reservoir through MR cooling coils.

An inter cooler safety valve is provided at the outlet of inter cooler (set at 4.2 Kg/cm^2) to save the inter cooler tubes from damages.

AIR SYSTEM:

The air charged in the MR1 reservoir is further sent into MR2 reservoir through a Non- Return valve. Also the MR1 air is utilized directly for 1. horns 2. wipers 3. sanders 4. To control circuit through a N1 reducing valve (set at 5 $kg./cm^2$) for the operation of BKT, REV and Power contactors. 5. MR equalizing pipe through a duplex check valve. 6. Feed pipe through a 1" FP COC and Feed valve (set at 6 Kg/cm^2) . 7. One connection for working of AC Governor. From the MR2 air reservoir the air is utilized for the brake system through a 'J' filter and COC.

AIR COMPRESSOR GOVERNOR

This governor is provided in the expressor room. A pipe line is connected from MR1 outlet through a COC to this governor. It controls the MR air pressure in the reservoirs between 10 and 8 Kg/cm^2. When the MR air reaches $10Kg/cm^2$, this governor will not allow the compressor to charge the reservoirs by keeping the un loader valves pressed provided on inlet side of both LP and HP cylinders. Mean time due to the utilization of air in the system, the MR pressure will drop to $8Kg/cm^2$. Then this governor stops operating un loader valves. As usual the compressor charges the MR air reservoirs. This process is called loading and unloading of compressor.

AUTO DRAIN VALVE(ABD VALVE)

The same AC governor also actuates the ABD valve provided on MR air reservoirs. This valve is meant for discharging the moisture from MR reservoirs during unloading and loading of compressor. A COC is provided for ABD valve which should be always kept in open condition. In case the MR air is continuously blowing COC may kept in closed condition.

EXPRESSOR LUBRICATING SYSTEM

The required lube oil for the expressor lubricating system is stored in expressor crankcase. The sump capacity is 30 ltrs. A chain driven lube oil pump is provided inside the crankcase. The pump forces the oil in the system during the working of expressor. A lube oil pressure indicator, called brass spindle unit is provided on the top of the crankcase. This brass spindle will project out with the help of lube oil pressure created in the system.

TROUBLESHOOTING INCASE OF BRASS SPINDLE NOT PROJECTING

1. Secure the loco
2. Keep the engine speed in idle condition.
3. Check for any unusual sound from expressor
4. Raise the engine rpm to second notch and observe for brass spindle projection
5. If not projected, slightly slack the screw available on brass spindle unit
6. Shake the screw and observe for lube oil coming out with pressure. If oil is not coming out, fully open the screw and check for any obstruction inside the hole.
7. If oil is coming, re-tight the screw and work onwards duly observing oil levels.
8. If oil is not coming, suspect for chain driven pump defective and shutdown the engine, to avoid expressor damage.
9. Take the advise for further action.

CRANKCASE VACUUM MAINTAINING VALVE(BREATHER VALVE)

While working the expressor due to the hot lube oil and escaped air from cylinders the crankcase is occupied with fumes and air. If this is continuously allowed, the crankcase may burst. To avoid this, a breather valve is provided on crankcase. The inlet of this valve is open to crankcase and the outlet is connected to exhauster cylinder inlet. During the working of exhausters along with the vacuum train pipe air, the crankcase air is also sucked and ultimately discharged in to atmosphere. To maintain the required vacuum, this valve is having a plunger which cuts off the outlet after required vacuum is created inside the crankcase.

If sufficient vacuum is not available the expressor lube oil will through from discharge pipe. In this condition, check for any loose oil filling plug or damaged copper pipe connections to avoid unnecessary oil loss.

DIFFERENT TYPES OF EXPRESSOR & COMPRESSOR ON DIESEL-ELECTRIC LOCOS

Sl. No.	Type Of Expressor/ Compressor	Locos On Which Provided	No. Of Exh. Cyl.	No. Of comp. Cyl.	Lube oil system	Crank case vacuum system	Other Modifications
01.	6CD-4UC	WDM2/ YDM4 &4A	04	02 (1LP & 1HP)	1. Type of Oil SP150 2. Capacity- 30 Ltrs. (max) 3. Oil level spy glass/ dip stick gauge 4. Chain driven/ gear driven lube oil pump 5. Brass spindle unit	The expressor crank case is connected to one side exhauster cylinders through BREATHER valve and copper pipe.	---
02.	6CD- 3 UC or KE-6	WDM2 (mod.) WDM3A (dual brake) WDG3A (dual brake) WDP1	03	03 (2LP & 1HP)	-do-	-do-	---
03.	Pure air compressor (ELGI-3CDB) (KCW-523/623)	WDM2B WDG3A (IRAB1) WDM3A (IRAB1)	-NIL-	03 (2LP & 1HP)	Lube oil pump is driven by a gear.	A breather pipe is provided on crank case to maintain vacuum in side the sump.	One extra after cooler is provided (on engine side) between HP outlet and MR cooling coils.

FUNCTION OF BRAKE VALVES IN BRAKE SYSTEM

1. A-9 AUTOMATIC BRAKE VALVE:

The A-9 brake valve is a compact, self-lapping, pressure maintaining brake valve which is capable of graduating in application and release of formation and locomotive brakes. It has five positions: Release, Min. reduction, Full service, Over reduction and Emergency. This valve will supply pressure to the outlet in release position itself and thus helps in charging of BP pipe pressure. This valve has a feed valve at the back of it and permit to adjust the BP pipe pressure to the required level.

2. VA1B CONTROL VALVE:

This valve controls creation, maintenance, and destruction of vacuum by the exhausters on the train pipe. The brake pipe pressure of 5 kg/cm^2 pilots the movement of this valve. When the brake pipe pressure is reduced by A9 valve, this valve lifts up and destroys vacuum in VTP. The special feature of this valve is that itself laps to the following vacuum pressures in different positions.

Sl.No.	Position	BP pressure	Vacuum in VTP
01.	Release	5 Kg/cm^2	56 cm.
02.	Min. reduction	4.5 Kg/cm^2	43-38 cm.
03.	Full service	3.5- 3.8 Kg/cm^2	25 cm.
04.	Over reduction	2.5-2.8 Kg/cm^2	0 cm.
05.	Emergency	0 Kg/cm^2	0 cm.

3. MU2B VALVE:

This valve is provided in Short Hood control stand in WDM2 locos and in nose compartment in modified locos. It has two positions Lead and Trail/Dead. In a single loco it should be in Lead position. If not neither BP nor BC pressure and also vacuum will not create. On the trailing unit of MU locos and in Dead loco attachment also it should be in Trail/Dead position to set up proper sequence of brake system in MU operation.

4. VA1 RELEASE VALVE:

This valve sets up according to the MU2B valve position and is located inside the nose compartment. When MU2B valve is in Lead, MR pressure will supply at the bottom of valve and opens it. Thereby communication between VA1B valve and VTP. When MU2B valve is in Trail/Dead, it close down due to spring tension. In MU trail loco this valve will be operated by A1 Differential valve.

4. D1 EMERGENCY BRAKE VALVE:

This valve is provided in driver's cab near both control stands. This has direct connection from VTP and BP pipe. In the case of BP/vacuum not destroyed by A9 valve or to apply brakes at emergency rate this valve must be operated to stop the train.
Note: This valve handle must be in lifted condition until the train stops and then only A9 valve defect to be investigated.

6. A1 DIFFERENTIAL PILOT AIR VALVE:

This valve is located inside the nose compartment with a COC. This valve has two functions: a) to nullify the HB5 valve operation during normal recreation of BP and Vacuum b) to supply air to lift VA1 release valve so as to connect VTP with the exhausters in trailing operation for faster vacuum recreation. Its COC must be kept in open in Lead or trailing locos.

7. 28VB PROPORTIONAL VALVE:

This valve is located in Short Hood control stand in WDM2 locos and in Nose compartment in New locos with a COC located in nose compartment. Its function is to actuate loco brakes in conjunction with the formation brakes that are applied by A9 valve. Its COC must be kept in OPEN in single loco and in MU trailing loco also. It brings air pressure on loco in proportion to the BP/vacuum dropped with A9. During A9 emergency the max. Brake cylinder pressure will be 1.8 Kg/cm^2 as limited by Limiting valve.

Its brakes are automatically nullified during dynamic brake by a valve called BKIV/ D1 pilot air valve. If SA9 valve is kept in Quick release in WDM 2 locos or if Foot pedal is pressed in modified locos these brakes are temporarily nullified BKIV / D1 Pilot valve.

8. GD 80D FILTER:

This filter is located inside the Nose Compartment. This filter is meant for filtering the atmospheric air sent into the train pipe through the VAIB Control valve during vacuum brake application. In some modified Locos a red cap is provided on the atmospheric line of this filter. When such Locos are hauled dead, the red cap must be fitted on the atmospheric Line. If not, there will be no creation of vacuum on the train.

9. GD 80E FILTER

This filter is also located inside the Nose compartment. It is meant for filtering the train pipe air drawn by the VAIB Control valve during creation of vacuum, when sufficient vacuum is not created, this filter must also be examined for any Air Leakage and must be arrested.

10. SA9 INDEPENDENT BRAKE VALVE:

The Locomotive independent air brake are applied and released by the SA9 Independent air brake handle located below A-9 handle on the control stand. This handle has 3 positions.

1.Release 2.application 3. Quick release.

RELEASE : This is the running position. The LOCO air brakes releases in this position.

APPLICATION : When SA9 is moved to this position LOCO air brake is applied to the desired pressure to a maximum of 3 kg/cm^2.

QUICK RELEASE : This position is a special feature of this valve. When this handle is pushed to quick release position, the LOCO brake working in conjunction with Vacuum destruction is nullified.

ADJUSTMENT OF LOCO BRAKE CYLINDER PRESSURE WITH SA9:

1. Keep SA9 Handle in Application position.
2. Keep MU2B in Lead position.
3. Keep Brake cylinder COCs in open.
5. Adjust SA9 feed valve to 3 Kg/cm^2.
6. Keep Brake cylinder equalizing COC close on 4 corners of the loco.

11. HB5 VALVE:

This valve with its COC is provided inside the long hood control stand in WDM2 locos and in modified locos inside nose compartment. Its function is to knockout the PCS when ever D1 emergency valve is applied or if suddenly vacuum is dropped below 38 cms.of Hg in vacuum formation, the HB5 valve operation causes engine RPM return to IDLE.

12. C2 RELAY VALVE:

This valve is fitted underneath the chassis on right side just below driver's cab in WDM2 locos and in modified locos inside the nose compartment. Its function is to relay brake cylinder pressure either initiated by SA9 valve or 28 VB/C3W distributor valve.

13. ADDITIONAL C2 RELAY VALVE:

This valve is fitted underneath the chassis on right side just below driver's cab in WDM2 locos and in modified locos inside the nose compartment. Its function is to relay brake pipe pressure initiated by A9 valve, i.e. to charge the Brake pipe with 5 Kg/cm^2 air when A9 valve in release and to reduce BP pressure when A9 valve brought into application zone.

14. C3W DISTRIBUTOR VALVE:

This valve is provided in IRAB1 brake system as well as dual brake modified locomotives for the purpose of getting conjunctional/ proportional loco brakes. It has 3 pipe connections - MR, BP and an outlet pipe for sending BC pilot air. It does the same function to that of 28 VB valve in conventional dual brake locomotives. It has manual release lever and also GOODS/PASSENGER handle. This handle to be kept in proper position according to type of formation working (wagons or coaches), Otherwise wheel skidding may occur. And to avoid conjunctional brakes , isolating handle to be close which is fitted near C3W Distributor valve.

15. F1 SELECTOR VALVE:

This valve performs the function of arranging the brake equipment on the locomotive to Lead or Trail other types of Brake equipment and ensures the operation of brakes in trail locomotive (s) when initiated from the lead locomotive. It also performs the function of protecting a trailing locomotive brake application by automatically resetting the brake control to lead position in the event of a separation between the locomotives.

The operation of F1 selector valve is under the control of MU2B valve.

In lead loco, when MU2B is in LEAD, F1 selector will help in transferring conjunctional brake cylinder pressure from 28VB valve/ Distributor valve for getting loco brakes.

In Trailing loco, when MU2B is in Trail/Dead position, this will communicate Lead loco brake cylinder equalizing pressure to trailing loco C2 relay valve to get brakes on trailing loco also.

In case of train parting, it automatically turns into lead to get brakes on parted loco.

16. HS4 AIR VALVE:

This valve reduces the MR pressure to a constant value as adjusted (usually 24 PSI (+/-) 1 PSI) and it acts under the VA1B control valve to support the vacuum in VA1B valve C chamber to balance BP pressure in A chamber.

This helps in adjusting the vacuum in Vacuum Train Pipe (VTP). By decreasing the HS4 pressure VTP vacuum can be increased. By increasing HS4 pressure vacuum in VTP can be reduced.

DESCRIPTION OF THE 28-LAV1 DUAL BRAKE SYSTEM

DESCRIPTION :

The functional details of the various main WABCO valves used in the system are individually described. However, general working of the 28-LAV-1 brake system is given below.

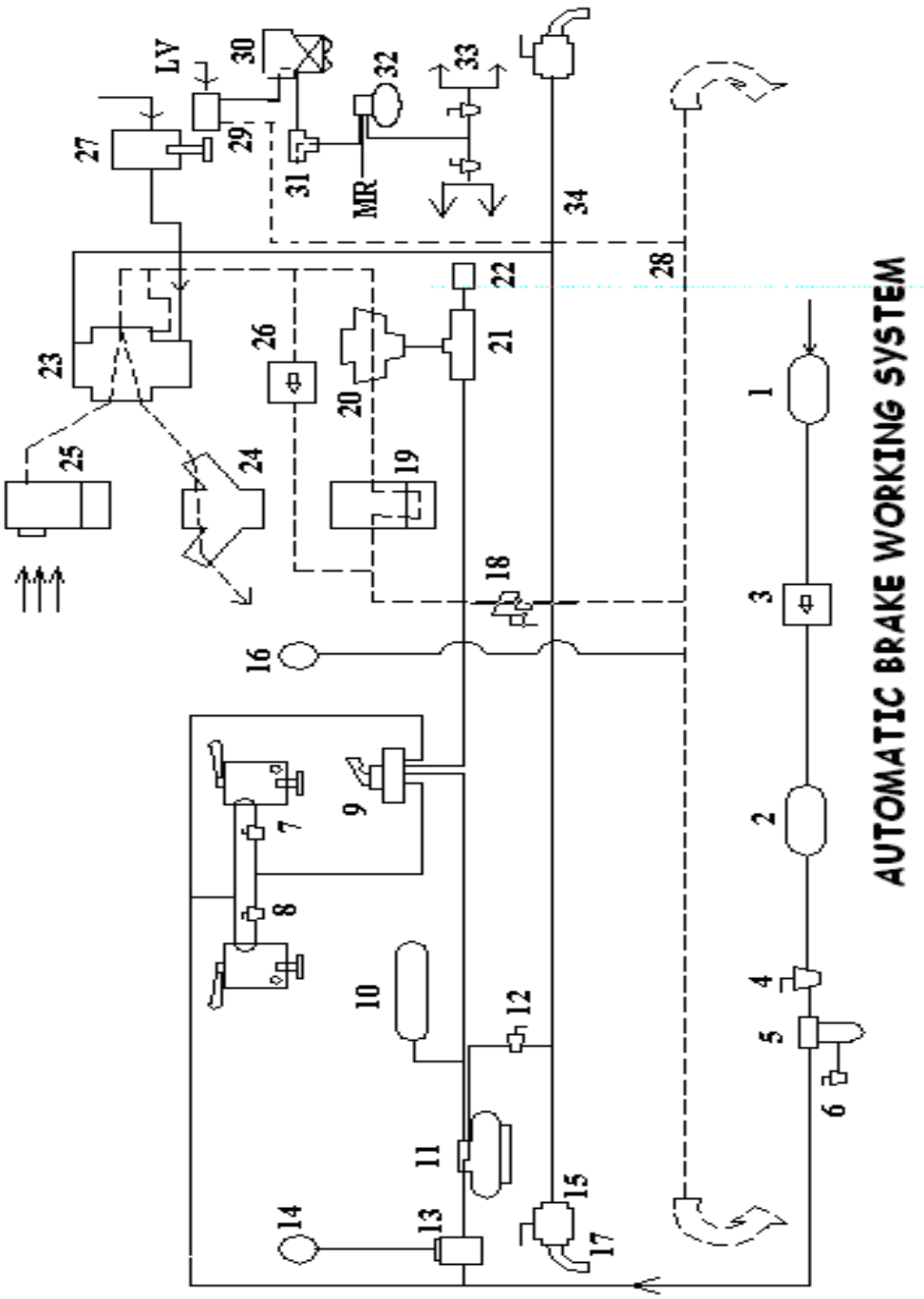
A9 AUTOMATIC BRAKE WORKING system :

At all times, the Expressor supplies compressed air through the Main Reservoir to A-9 Automatic Brake Valves, C-2 Relay valve, additional C-2-W Relay valve. And in lead position of the MU-2B valve, the main reservoir air is supplied to VA-1 Release valve to connect vacuum brake pipe to VA-1-B control valve port 6. In a similar manner, the exhauster portion of Expressor is connected to vacuum train pipe through VA-1-B control valve port 7 to create vacuum in the train pipe.

BP CHARGING :

In release position of the A-9 automatic brake valve, which is used for controlling locomotive and train brakes, main reservoir air flows to its regulating portion, which it is reduced to a predetermined pressure of 5 kg/cm^2. The regulated air pressure flows through the A-9 brake valve, MU-2B valve and then to the control port of additional C-2-W relay valve. The air brake pipe (BP) is charged rapidly through the additional C-2-W relay valve, to 5 kg/cm^2. The main reservoir air charges the feed pipe (FP) through D-24-B Feed valve set at 6 kg/cm^2 and it remains charged throughout all the processes of brake application and release. With the air brake pipe charged VA-1-B control valve is actuated and the control valve piston is moved downward to connect the exhauster pipe to the vacuum train pipe. The 28-VB control valve connected to the vacuum train pipe is thus positioned in release position connecting the brake cylinder control pipe to C-2 relay valve to exhaust, and thus releases locomotive brake via C-2 Relay valve exhaust.

The HS-4 control air valve is provided for adjusting the degree of vacuum desired in the vacuum train pipe.


AUTOMATIC BRAKE WORKING SYSTEM
LV
MR
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34

AUTOMATIC BRAKE SYSTEM WORKING PARTS

1. MR1 AIR RESERVOIR
2. MR2 AIR RESERVOIR
3. NON-RETURN VALVE
4. BRAKE SYSTEM COC
5. J-FILTER
6. DRAIN COCK FOR J-FILTER
7. S/H A9 BRAKE VALVE
8. L/H A9 BRAKE VALVE
9. MU2B VALVE
10. 110 CU. INCH RESERVOIR
11. ADDITIONAL C2 RELAY VALVE
12. 3/4" BP COC
13. AIR FLOW MEASURING VALVE
14. AIR FLOW INDICATOR
15. BP ANGULAR COC (GREEN)
16. VTP GAUGE
17. BP HOSE PIPES
18. BANKING COC
19. GD 80 E FILTER
20. VA I RELEASE VALVE
21. 24 -DCV
22. A1 DIFFERENTIAL PILOT VALVE
23. VA 1B CONTROL VALVE
24. EXPRESSOR
25. GD 80 D FILTER
26. NON RETURN VALVE
27. HS 4 VALVE
28. VACUUM TRAIN PIPE
29. 28 VB VALVE
30. F1 SELECTOR VALVE
31. 24 DOUBLE CHECK VALVE
32. C2 RELAY VALVE
33. BRAKE CYLENDERS
34. BP PIPE LINE

SERVICE :

When it is desired to apply simultaneously the locomotive and the train brakes, the Automatic brake valve is moved into the service brake zone permitting control air pressure to drop at a service rate at the automatic brake valve exhaust port. This operates the additional C-2-W relay valve to deplete the brake pipe air at a faster rate. The reduction in brake pipe pressure operates the VA-1-B control valve and moves up to admit the atmospheric air into the vacuum train pipe. The destruction of vacuum in vacuum train pipe is in proportion to the brake pipe pressure reduction made. The 28-VB control valve respond to the loss of vacuum in the vacuum train pipe to apply locomotive brakes through C-2 relay valve, simultaneously, the vacuum brakes in the trailing stock are applied due to the destruction of vacuum via the VA-1-B control valve and on air braked trailing stock the brakes are applied due to depletion of brake pipe pressure. A limiting valve set at 1.8 kg/cm^2 is also provided in this circuit so that brake cylinder pressure on locomotive does not increase this value during automatic brake application. After the desired brake pipe reduction has been made, the Automatic brake valve and additional C-2-W relay valve will lap. In lap position of the valves the brakes are held applied through out the train until the further brake pipe reduction or charging is made and the A-9 brake valve and the additional C-2-W relay valve exhaust ports to atmosphere are closed, stopping further reduction in brake pipe pressure. At the VA-1-B control valve the control piston moves down to close the vacuum train pipe port 6 from atmosphere. With the force equalized on both sides of 28-VB control valve large diaphragm, the inlet valve seats under the action of its spring. Thus cuts off air supply from the main reservoir to the brake cylinder control pipe. At the C-2 relay valve control pipe pressure will open the supply valve and permit main reservoir air to flow to the brake cylinders until equalization is achieved across the diaphragm of C-2 relay valve. When equalization is achieved, the supply valve will be closed, cutting of if main reservoir supply air to brake cylinder. In the event of leakage in brake cylinder, the diaphragm piston of C-2 relay valve will again move to allow main reservoir supply air to recharge brake cylinder to maintain pressure at the desired level.

RELEASE AND RECHARGE :

To release the brakes after brake application the A-9 automatic brake valve is moved to release position opening the inlet valve of the regulating portion of A-9 brake valve to supply air to the control pipe of additional C-2-W relay valve which in turn will operate and supply air at a faster rate to the brake pipe, as described before, The increase in brake pipe pressure operates the VA-1B control valve which actuates 28-VB control valve. The release of the brake cylinder control pipe pressure at the 28-VB control valve causes the C-2 relay valve to open the exhaust port. Thus, brake cylinder pressure will flow to exhaust at the C-2 relay valve exhaust port.

On the vacuum braked train, the increase in brake pipe pressure operates the VA-1-B control valve to connect the vacuum train pipe to the exhauster portion of the expressor for evacuating the entire train pipe and thus releasing the vacuum brakes throughout the train.

EMERGENCY :

When it is desired to make the shortest, possible stop, the Automatic Brake valve is moved to "Emergency" position, opening the air brake pipe directly to atmosphere at the brake valve vent valve. The rapid reduction in the brake pipe pressure operates the VA-1-B control valve and thereby the 28-VB control valve to quickly connect regulated air pressure to the locomotive brake cylinders and also applies the brakes on air braked train. On the vacuum braked train, the rapid drop in air brake pipe pressure causes a quicker movement of the VA-1-B control valve into application in the trailing stock than in a full service application is obtained.

Release after emergency takes place in the same way as described under "Release and Recharge"

SA-9 INDEPENDENT BRAKE :

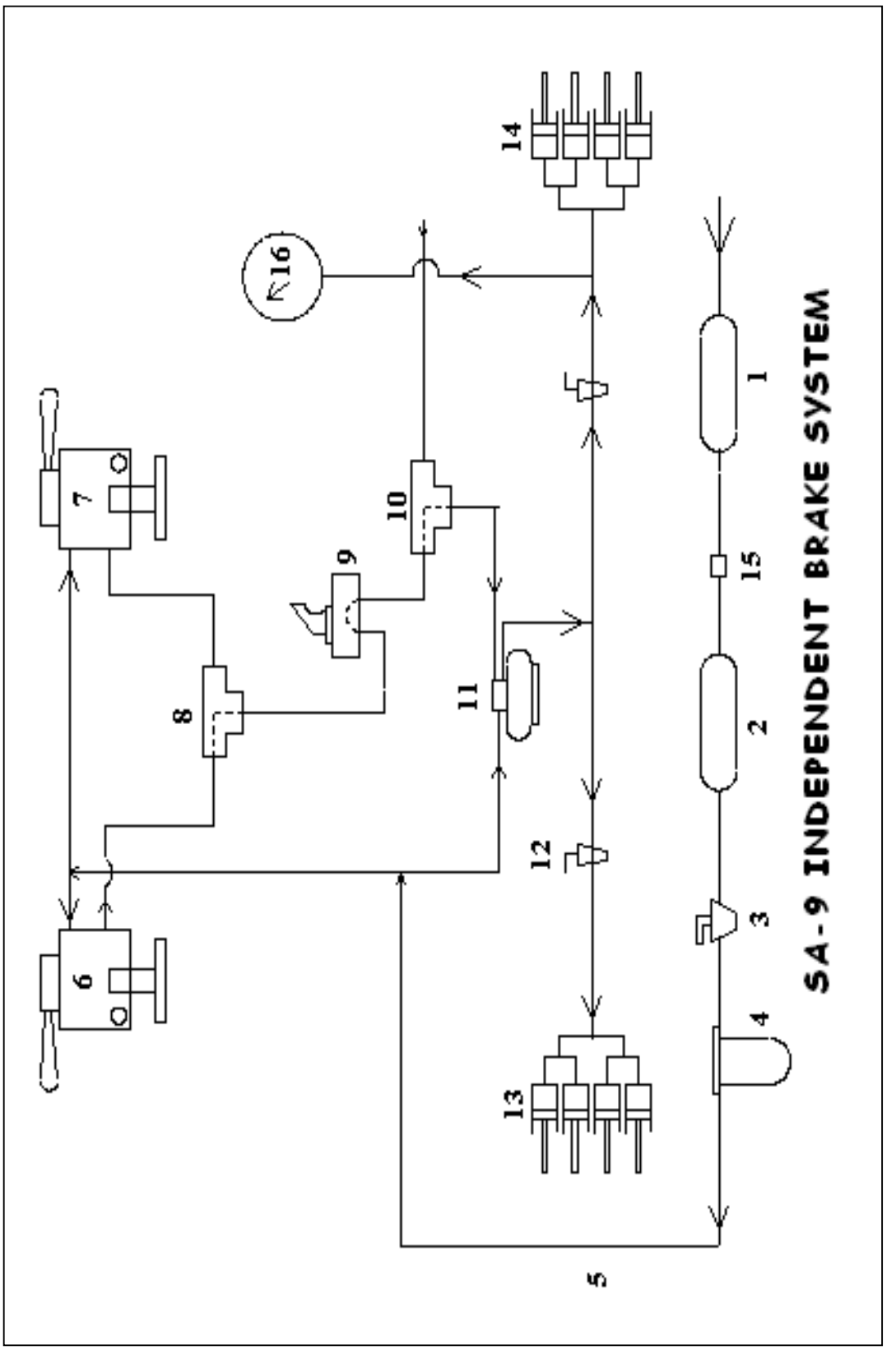
The locomotive brakes may be operated independent of the train brakes at any time by proper movement of the SA-9 independent brake valve handle. The SA-9 independent brake valve is connected through a double check valve to the C-2 relay valve that controls brake cylinder pressure build up.

APPLICATION :

If it is desired to apply the locomotive brakes only, the SA-9 Independent brake handle is moved to the application zone. This allows main reservoir supply air to flow through double check valve, separating the two SA-9 Independent brake valves, the independent application and release pipe and through the double check valve to actuate the C-2 relay valve which will supply air pressure to the brake cylinders in proportion to brake valve handle movement.

RELEASE :

To release the locomotive brakes the SA-9 independent brake valve is moved towards release position venting the air in the brake cylinder control pipe to the C-2 relay valve, at the independent brake vale, in proportion to brake handle movements, thus allowing C-2 relay valve to connect the brake cylinder air pressure to exhaust at the C-2 relay vale. Thus, the locomotive brakes may be gradually applied or released with the SA-9 independent brake valve without affecting the train brakes.

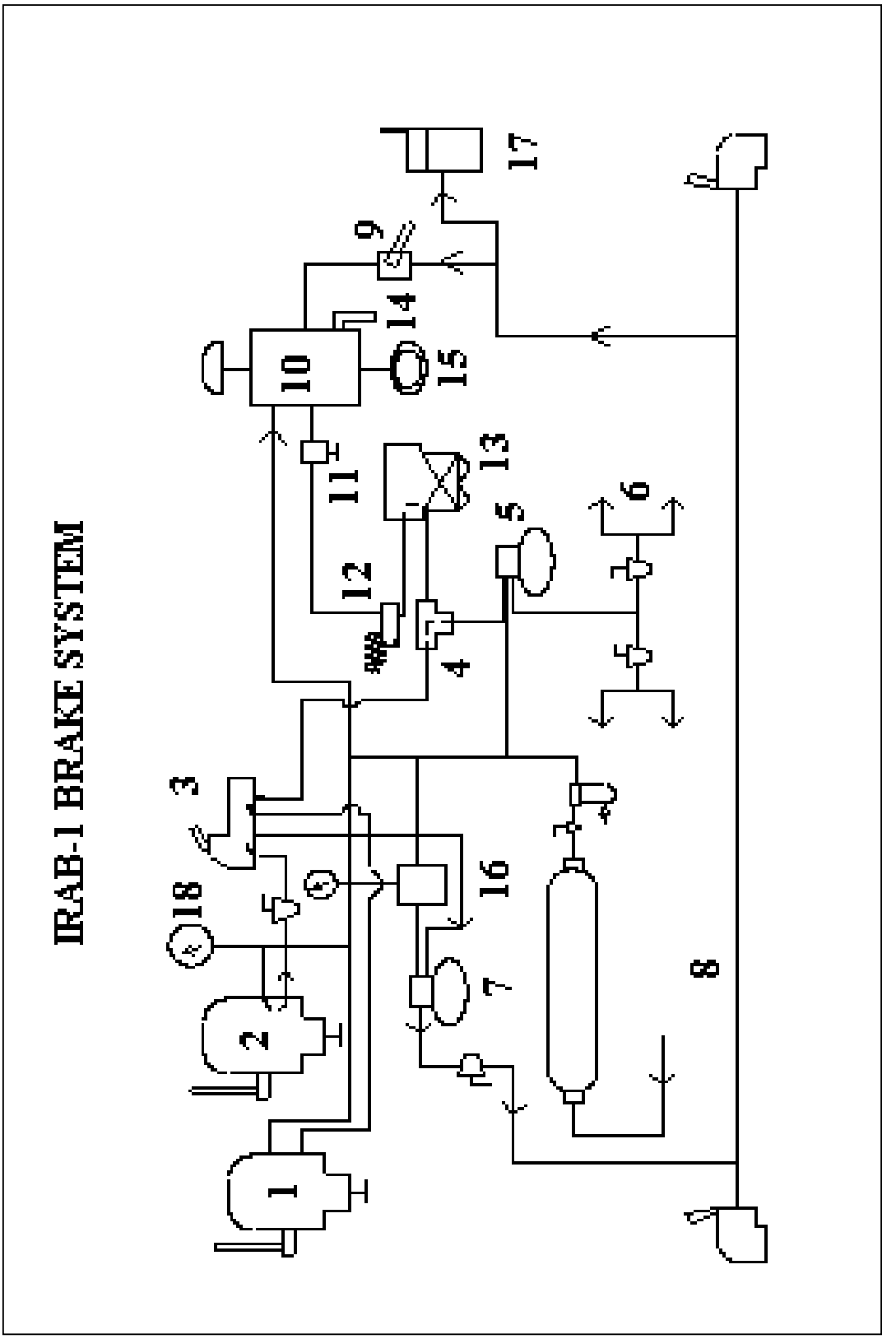

SA-9 INDEPENDENT BRAKE SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16

SA9 BRAKE VALVE CIRCUIT

1. MR1 RESERVOIR
2. MR2 RESERVOIR
3. BRAKE SYSTEM *COC*
4. J-FILTER
5. MR AIR CONNECTION TO VALVES
6. S/H SA9 VALVE
7. L/H SA9 VALVE
8. 24A DOUBLE CHECK VALVE
9. MU2B VALVE
10. 24A DOUBLE CHECK VALVE
11. C2 RELAY VALVE
12. BRAKE CYLINDER *COC* (FT & RT)
13. BRAKE CYLINDERS (RT)
14. BRAKE CYLINDERS (FT)
15. NON-RETURN VALVE
16. BRAKE CYLINDER PRESSURE GAUGE

QUICK RELEASE :

If the automatic brake is applied and it is desired to release the locomotive brakes only, the SA-9 independent brake valve handle is moved to quick release position. This in turn destroys the balance across the large diaphragm of 28-VB control valve, causing the service valve to return to release position and thereby venting the brake cylinder control pipe pressure of C-2 relay valve which in turn releases the brake cylinder pressure on the locomotive without affecting the train brakes.


IRAB-1 BRAKE SYSTEM
17
9
14
10
15
11
13
5
6
12
4
3
18
16
7
8
2
1

IRAB-1 BRAKE SYSTEM PARTS:

1. SA9 INDEPENDENT BRAKE VALVE
2. A9 AUTOMATIC BRAKE VALVE
3. MU2B VALVE
4. 24 DCV
5. C2 RELAY VALVE
6. BRAKE CYLINDERS
7. ADDITIONAL C2 RELAY VALVE
8. BRAKE PIPE
9. ISOLATING HANDLE
10. DISTRIBUTOR VALVE
11. LIMITING VALVE
12. D1 PILOT VALVE
13. F1 SELECTOR VALVE
14. G/P HANDLE
15. MANUAL RELEASE HANDLE
16. AIR FLOW INDICATOR
17. D1 EMERGENCY BRAKE VALVE
18. MR GAUGE

ACCORDING PLACEMENT OF AIR BRAKE VALVES FURTHER BRAKE SYSTEMS

ARE CLASSIFIED AS :

1. Conventional brake system (BP coc provided in driver's cab)
2. Modified brake system.

Modified brake system further classified as

1. Rack mounted brake system (BP coc provided behind the rack in the nose compartment)
2. Panel mount brake system (BP coc provided on panel itself in the nose compartment)

With the Panel mount brake system most of the pipe lines are avoided , due to that air brake failures will be less as well as easy for maintenance. Panel mount brake system further classified as

1. Single panel mount brake system (for pure IRAB locos)
2. Single panel mount brake system (for Dual brake locos)
3. Tri panel mount brake system (for Dual brake locos).

COMPARISON BETWEEN CONVENTIONAL DUAL BRAKE LOCO AND

MODIFIED DUAL BRAKE LOCO.

Conventional Dual Brake	Modified Dual Brake
SA9 will have three positions	SA9 will have two positions
For conjunctional brake 28 VB valve provided.	For conjunctional brake Distributor valve provided
For releasing the conjunctional brake temporarily, SA9 to keep quick release position	Foot pedal to operate.
To isolate conjunctional brakes permanently , 28 VB COC to be close	Isolating handle to be close
¾" COC available in Driver's Cabin	1" BP COC available in nose compartment

WOOD WARD GOVERNOR

Functions of Governor:

1. During Engine starting allowing the fuel in proper time.
2. After starting the engine, it keeps the engine to run in idle speed.
3. Increase engine speed as per notch position.
4. Reduce engine speed as per notch position.
5. Maintain constant speed of the engine at concerned notch.
6. Maintain constant speed of the engine of concerned notch even at load variation.
7. Matching the load demand with the engine output.
8. To stabilize the engine speed even any slight variations.
9. Economical fuel supply.
10. To protect and keep safety of the engine low lube oil pressure, low cooling water etc.
11. To function for normal Engine shut down operation.

CONNECTIONS:

The following items to be check thoroughly on WW governor

1. Check the availability of oil through spy glass.
2. Check the condition of amphenol plug.
3. Ensure no oil leakages.
4. Ensure proper fitment of lube oil pipe line.
5. Ensure proper fitment of booster air pipe line.
6. Ensure proper fitment of governor linkage along with cotter pins.
7. Ensure position of the LLOB.
8. Ensure the Physical condition of LCR.

TRUCK–6 WHEEL-3 MOTOR (WDM2 & WDM3A)

WDM2, & WDM3A class broad gauge locomotives built by the Diesel Locomotive Works are fitted with Alco's TRIMOUNT rigid bolster, swivel type, three individually motored axle bogies (Co-Co type).

Each axle is driven by an individual motor suspended on axle by suspension bearings and rested on bogie frame by resilient pad. The traction motor (TM) armature and axle are connected through PINION and BULL GEAR. This pinion and bull gear are covered by a gear case. The gear case is filled with cardium compound (Blue Coat-3) to lubricate the gears. This gear case unit is made in two halves secured by 04 vertical bolts. The gear case is connected to traction motor by three horizontal bolts.

The tri-mount bogie consists of a single piece cast steel frame, which is having a centre pivot (swivel bearing) carried in the cross member located between the leading and middle axles and two load bearers which are carried in cross member of the frame between the middle and trailing axles. The weight of the locomotive body is transferred to the bogie at the pivot and at the two load bearers to form a three point support.

The centre pivot carries approximately 60% of the vertical load and also receives and transmits traction and braking forces while the two side load bearers share the remaining 40% of the vertical load. The load bearers are not transmitting any traction or braking forces.

The centre pivot and the side load pads arrangement helps to minimize weight transfer due to tractive effort or braking force and maintain a higher factor of adhesion in service.

The cylindrical pivot liner transmits traction and braking forces and the circular liner receives the vertical load. The pivot bowl and loading pad oil pans are filled with oil for lubrication of these liners. The oil pans are provided with dust shields. Resilient liners are provided between the foot of the loading pad and the bearing shoe.

The lateral spacing of the side load pads afford stability to prevent the tipping forces of the locomotive and the frictional resistance of the pads prevent nosing.

The truck is provided with Single stage suspension consisting of long deflection helical springs (inner and outer). Friction snubbers are provided inside of each left side spring groups. The frame is supported by these springs on four sets of double equaliser beams (inner and outer eqiualising breams). Suitably positioning the springs on the equaliser and controlling their working heights obtain full equalisation between adjacent wheels.

The bogie frame is secured the chassis by collar pins provided on both sides of centre pivot and a "U" bracket.

Movable axle journal boxes are mounted in pedestals cast integral with the frame. The movement of the boxes in the pedestals obtains the lateral play for negotiating passage over curves and turnouts.

The bogie frame consists of 4 brake cylinder units on corners of bogie to operate brake rigging mechanism. Clasp brakes are provided for wheels (two brake blocks on each wheel). Manually operated slack adjusters (palm type or screw type) are fitted to adjust for wheel and brake shoe wear. The truck also consisting of brake cylinder pipes to supply air to brake cylinders.

The design features of this bogie are oriented towards simplicity; the absence of the secondary suspension has resulted in a lowering of the centre of gravity while the 3 - point , widely spaced, loading helps to keep weight transfer to a minimum. Side equalisation is conducive to riding stability over indifferently maintained secondary tracks. This bogie is inherently suitable for freight and medium speed passenger operation.

The trucks are so positioned under the locomotive that the larger pad is located towards the centre of the locomotive. The pads thus form a three point support which carries the total load on each truck.

The lateral spacing of the pads afford stability against the tipping forces of the locomotive on a curve, and the frictional resistance of the pads prevents nosing at high speed.
The following important items and safety fittings are to be examined while working with this type of trucks:

1. Both trucks 4 collar pins and two U brackets should be intact in position.

2. Oil must be available in 2 Centre Pivot oil cups and 4 side bearer oil cups.

3. Check 8 pairs of compensating beams for any external cracks on split ends. Roller pins must be seated properly on end axle boxes. Each beam tie-rod with cotter and spring seater U clamp must be intact. No rubbing of equalising beams with bogie frame.

4. 16 pairs of truck coil springs must be intact in position. A minimum of 3 mm gap must be available between coil wires. No breakage is allowed on outer or inner coil springs.

5. Axle boxes should be checked for hotness. No splashing of grease from axle boxes. Horn cheek & Axle box liner plates must be intact. The stay plates must be held in position under each axle box with two bolts and nuts.

6. Check for any damage of traction motor air bellows.

7. Check for intactness of gear case bolts (both horizontal & vertical) and sealed.

8. Check for nose cap bolts intactness and sealed.

9. Check for wick pad availability and bolts sealed.

10. Resilient pads must be seated properly on bogie and stay bolts are intact.

11. Check for any external cracks on bogie frame near axle box horn cheeks and at cross beams.

12. Check for brake hanger pins intactness and pull rod safety clamps.

13. Check axle driven alternator and speedometer pulse generator/ speed sensor intactness on axle boxes.

14. All brake block cotters should be intact and pull rod safety bracket should not be missing.

15. There should not be any missing or loose items in under gear.

TRUCK 6-WHEEL 3-MOTOR (WDG3A) (HIGH ADHESION BOGIE):

This is a 3-axle type bolster-less bogie with two stage suspension, floating type centre pivot and unidirectional arrangement of axle-hung, nose suspended traction motors. Bogie frame is of straight and fabricated box type construction with three transoms to carry nose suspension.

The loco body weight is supported on bogie frame through four rubber side bearers directly mounted on bogie side beams. Centre pivot does not take any vertical load and is used only for transferring traction and braking forces.

The bogie frame in turn is supported on axle through helical coil springs mounted on equalising beams. The equalising mechanism consists of equalisers hung directly on end axle boxes and supported on middle axle box through a link and compensating beam arrangement.

Four vertical hydraulic dampers are provided one at each spring group. Two lateral hydraulic dampers are provided in each truck between chassis and bogie by the side of centre pivot. Shackles (U clamps) are provided on four corners of bogie to avoid run-out of bogie from chassis. Stops are provided on bogie frame to limit vertical movement of axle boxes. Side stoppers are provided two for each bogie to restrict the lateral movement of bogie in curvatures.

Each bogie is fitted with unidirectional arrangement of traction motors.

Bogies are provided with conventional brake gearing and sand boxes also provided on bogie frame itself.

In addition to the normal checks done on conventional bogies, the following extra checks to be done on these trucks:

1. Proper position of compensating beam (Observe for any drooping of beam to any one side).
2. Check for intactness of all equalising beam pins under axle boxes, links and compensating beams.
3. Check for availability of vertical stops under axle box horn cheeks.
4. Check for vertical and horizontal hydraulic dampers connecting bolts and their safety cotters intactness.
5. Check for any damage on sand-witch side load pads and their dislocation from position.
6. Check for intactness of 'D' shackles connected between chassis and bogie frame on four corners of bogie.
7. Check for any loose/ hanging/missing parts.

Truck - 4 Wheel – 2 Motor (BO-BO type)

This type of truck is fitted in WDP1 locomotives. It is having fabricated bogie frame with 2 axles (4 wheels) in each truck. It is also a bolster less bogie with two stage suspension. The traction motors are suspended on axle with a nose and suspension bearings and rested on bogie frame with resilient pad.
The locomotive body weight is supported by bogie frame through TWO groups of helical springs mounted on bogie side beams. The bogie frame is supported on axles through helical coil springs mounted on equaliser beams suspended below axle box. Centre pivot does not take any vertical load and is used only for transfer of traction and braking forces.

Each truck consists of four vertical hydraulic dampers on at each axle box. Two vertical hydraulic dampers and two lateral (horizontal) hydraulic dampers are provided between locomotive under frame and the bogie.

Vertical stops are provided to limit the vertical movement between the axle boxes and the bogie frame and between the bogie and under frame. Two lateral (side) stoppers are provided for each bogie with a rubber pad to limit the horizontal movement of bogie.

In this loco, each wheel is fitted with 4 brake blocks.
The truck is having TM gear case arrangement on alternate sides (L/R –L/R).
Instead of conventional brake rigging mechanism (with brake cylinders on four corners of bogie and linkages) this loco is provided with Tread Brake Unit (TBU) which has built-in parking brake and slack adjustment mechanism.
Other than checks done on conventional truck, the following checks to be done:

1. Check for correct fitment of hydraulic dampers.
2. The coil springs fitted between chassis and bogie to be checked for any damage.
3. If heavy oscillation comes check for the condition of centre pivot.

TROUBLE SHOOTING

I. Reasons for fuel oil pressure dropping even though fuel pump motor working

1. Less fuel oil in the tank.
2. Fuel trap may be dirty.
3. Primary and secondary filters may be chock.
4. Suction pipes may be air drawing.
5. Relief & regulating valves may be struck up in open condition.
6. Love joy coupling may be slack.
7. Delivery pipes may be leaking.
8. Fuel booster pump may be defective.
9. Gauge pipe line may be damaged.
10. Fuel oil pressure gauge may be defective.
11. Water contaminated with fuel.

II. Reasons for lube oil pressure dropping:

1. Less lube oil in the sump.
2. Lube oil pump may be defective.
3. Relief & regulating valves may be struck up in open condition.
4. Delivery pipes may be leaking.
5. Filter drum filters may be chocked.
6. Filter drum 'o' ring may be damaged.
7. Filter drum & strainer casing drain cocks may be partially open.
8. Strainer may be dirty.
9. Lube oil gauge may be defective.
10. Gauge pipe line may be damaged.

Note: If lube oil pressure not building during starting, Do not try to recrank several times other wise batteries may be discharge.

III. Reasons for water temperature raising and hot engine alarm:

Due to LWS:

1. Malfunctioning of LWS .
2. 3 way COC may be closed.
3. Water level drops below one inch from the bottom of the tank.

Due to ETS:

4. Water temperature above $90^{0}C$.
5. Radiators may be choked.
6. Radiator room door may be open
7. ECC may be defective
8. Radiator fan not working
9. Continuous load on engine
10. Less water in expansion tank
11. Atmospheric air temperature may be high

12. Right angle gear box may be defective
13. R-1 and R-2 contactors may be defective.
14. Right angle gear box may be defective
15. R-1 and R-2 contactors may be defective.
16. TS-1,TS-2 &ETS may be defective or malfunctioning or setted wrongly.
17. Water pump may be defective.

IV. Reasons for turbo back pressure (surging):

1. Faulty injection system .
2. Improper nozzle ring gap.
3. After cooler blocked.

V. Reasons for turbo oil throwing:

1. Turbine end oil seal may be defective.
2. Piston rings may be weak.
3. Liners may have ovality.

VI. Reasons for booster air pressure dropping or hauling power poor (mechanical reasons) :

1. Fuel oil pressure dropping
2. Exhaust gasket between head & manifold may be given up
3. Exhaust manifold may be cracked
4. Turbo super charger may be defective.
5. Turbo to after cooler housing flange joint gasket may be given up.
6. Intermediate casing joint gasket may be given up
7. After cooler housing to engine block joint gasket may be given up
8. After cooler to after cooler housing joint gasket may be given up
9. Air inlet elbow top & bottom gasket may be given up
10. Booster air gauge may be defective or BAP pipe line may be damaged.

VII. Reasons for brass spindle not projecting:

1. No oil in the expressor sump
2. Lube oil pump chain may be cut
3. Lube oil pump may be defective
4. Brass spindle itself defective
5. Expressor lube oil relief valve defective
6. Expressor choke pipe may be leaking.
7. Expressor lube oil pump strainer may be dirty.

VIII. Reasons for expressor oil throwing:

1. Excess oil in the expressor sump
2. Piston rings may be weak
3. Breather valve may be defective
4. Oil filling cap not secured properly
5. Breather valve copper pipe may be damaged
6. Both side inspection door gaskets may be given up or bolts may be slack
7. Both side oil seals air drawing
8. Bayonet gauge not secured properly
9. Expressor crank case may be cracked

IX. Reasons for MR pressure dropping:

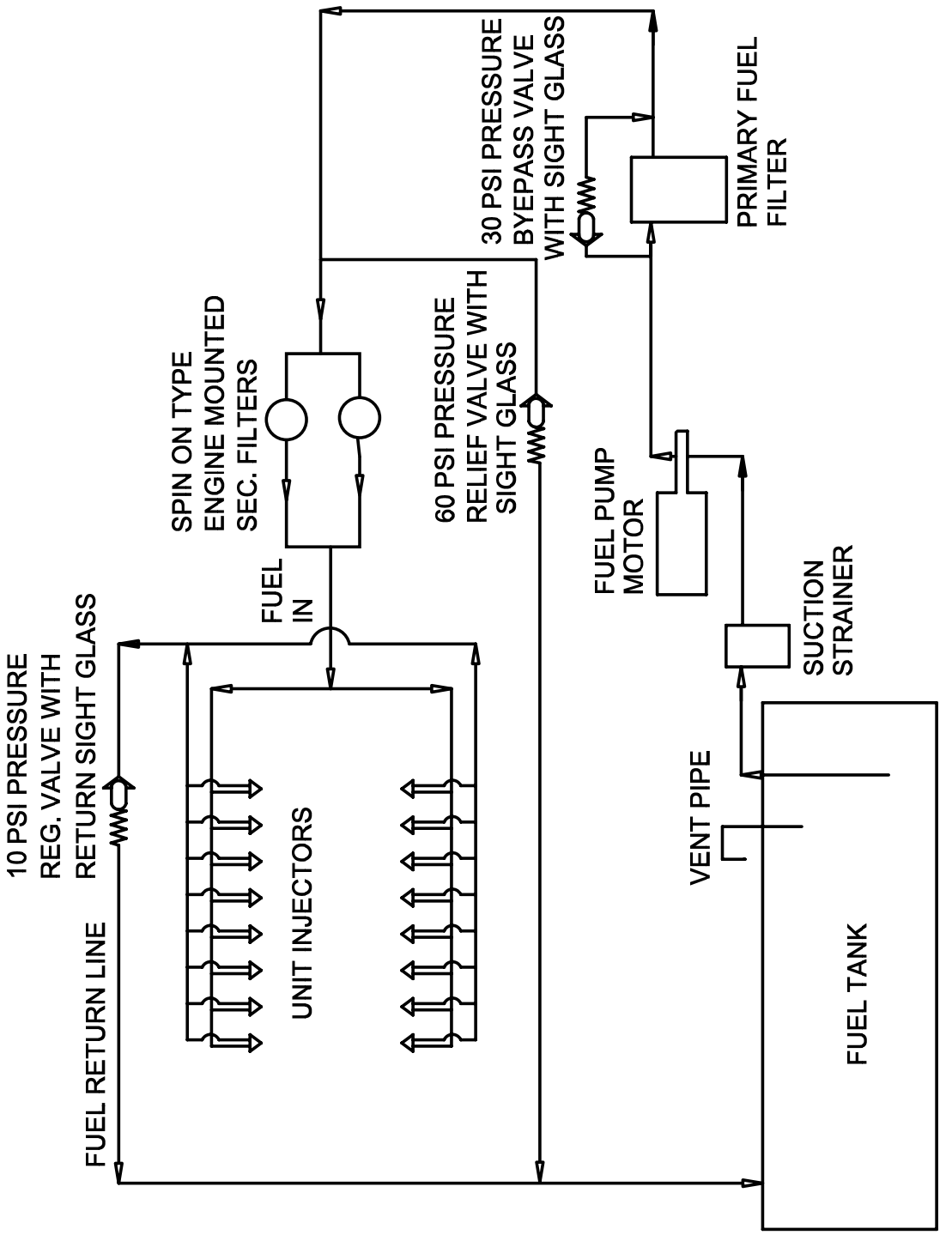
1. MR1, MR2 drain cocks may be open
2. Auto drain valve may be continuously blowing
3. BP, FP, MR, BC equalizing pipes may be opened to atmosphere
4. Expressor pipe line may be leaking very badly
5. Inter cooler tubes may be damaged
6. Inter cooler safety valves may be defective or dropped
7. AC governor may be malfunctioning
8. Compressor valves may be defective
9. MR gauge may be defective
10. Piston rings heavy blow-bye.

X. Reasons for BP not charging:

1. Less MR pressure
2. A-9 may be in application
3. Both side control stand A9 coc may be closed
4. MU2B in dead condition
5. $\frac{3}{4}$" coc may be closed
6. Firemen emergency may be in open condition
7. Additional c-2 relay valve may be defective
8. A-9 feed valve not adjusted properly
9. Both side BP angular coc may be open

XI. Reasons for vacuum not creating:

1. Less BP pressure
2. A-9 may be in applied position
3. MU-2B in dead condition
4. D-1 emergency may be in open condition
5. VA-1B valve may be defective
6. VA-1 release may be defective
7. HS-4 not adjusted properly
8. Banking coc may be closed
9. Both side vacuum hose pipe not secured properly
10. GD-80D & GD-80E filters may be chocked



FUEL OIL SYSTEM OF GT46 MAC LOCO

FUEL SYSTEM IN WDG4/WDP4

Fuel oil system consists of following components:-

1. Fuel tank of 6000 Liters capacity
2. Fuel suction strainer
3. Fuel oil pump (AC motor driven constant RPM fuel pump)
4. Fuel primary filter
5. Fuel secondary (Engine mounted spin – on filters)
6. Fuel headers
7. Unit fuel injectors.

The Total fuel system divided as:

1. Fuel feed system and
2. Fuel injection system

FUEL FEED SYSTEM:

Fuel pump draws fuel oil from fuel tank through fuel suction strainer which is a fine wire mesh strainer and pumps oil to fuel primary filter which is placed horizontally on the top of the lube oil filter tank, on engine equipment rack. Fuel primary filter is having single filter element which filters the fuel oil and it goes to engine mounted secondary filters. A bye pass valve and gauge is provided across the fuel primary filter and the bye pass valve is set to 30 psi which by passes the fuel passing through fuel primary filter element whenever the filter element is clogged and the differential pressure crosses 30 psi. The bypass gauge provided at the left free end side of the engine indicates the condition of fuel primary filter element, the gauge scale having green yellow and red zones. All ways the needle should be in green zone which indicates the normal operation of filter elements. Whenever needle shows yellow or red zones primary filter should be renewed.

Fuel oil further goes to engine mounted spin on secondary filters secondary filtration of fuel oil is done in these two engine mounted filters and then fuel enters both bank fuel headers. Fuel oil will be available always in both the fuel headers when ever fuel pump motor is on. At the end of the fuel headers after sufficient fuel is supplied to all the fuel injectors fuel returns to fuel tank through return fuel sight glass which is mounted on the top of secondary spin on filter which is nearer to engine block.

A check valve is set between 5 to 10 psi is provided in the return line maintaining this pressure always in fuel headers.

NOTE:- Return fuel sight glass should be always in filled condition whenever fuel pump is on and should not have any bubbles.

A 60 psi bypass relief valve is provided before the fuel spin ON filter which opens when the fuel spin on filter clogged and returns the fuel back to fuel tank avoiding unfiltered fuel oil entering into fuel headers. Thereby the damages to fuel injectors will be avoided.

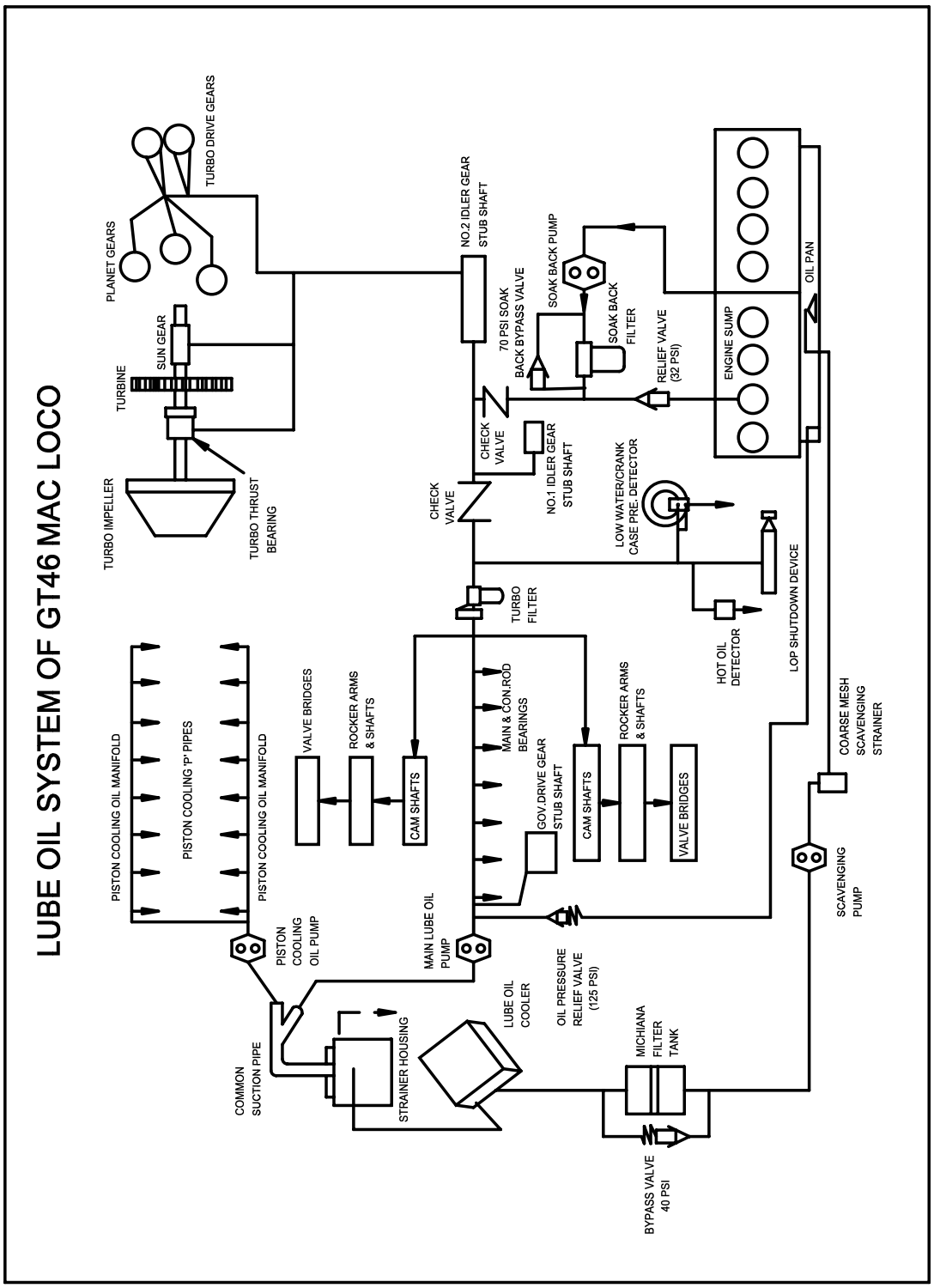
This by passing of fuel oil from spin "ON" filters can be seen in the fuel by pass sight glass, which is provided on spin "ON" filters. This bypass sight glass should be always empty.

If any oil in by pass sight glass is noticed, it is to be informed to home shed for changing filters.

FUEL INJECTION SYSTEM :-

Fuel oil supplied by fuel feed system is always readily available in both fuel headers, fuel injectors, whenever the fuel pump is on. When engine is started according to the timings individual unit injectors will pressurizes and injects the fuel in to the cylinders in atomized form. These fuel injectors are operated by over head cam and fuel rocker arm mechanism.

The quantity of the fuel injected will be controlled by the engine mounted Woodward Governor according to the notch and load conditions through fuel control shaft, linkage mechanism and fuel racks.


LUBE OIL SYSTEM OF GT46 MAC LOCO
TURBO DRIVE GEARS
PLANET GEARS
SUN GEAR
TURBINE
TURBO IMPELLER
TURBO THRUST BEARING
NO.2 IDLER GEAR STUB SHAFT
70 PSI SOAK BACK BYPASS VALVE
SOAK BACK PUMP
SOAK BACK FILTER
RELIEF VALVE (32 PSI)
ENGINE SUMP
OIL PAN
CHECK VALVE
NO.1 IDLER GEAR STUB SHAFT
CHECK VALVE
LOW WATER/CRANK CASE PRE. DETECTOR
TURBO FILTER
HOT OIL DETECTOR
LOP SHUTDOWN DEVICE
PISTON COOLING OIL MANIFOLD
PISTON COOLING 'P' PIPES
PISTON COOLING OIL MANIFOLD
VALVE BRIDGES
ROCKER ARMS & SHAFTS
CAM SHAFTS
MAIN & CON.ROD BEARINGS
GOV.DRIVE GEAR STUB SHAFT
CAM SHAFTS
ROCKER ARMS & SHAFTS
VALVE BRIDGES
COARSE MESH SCAVENGING STRAINER
SCAVENGING PUMP
PISTON COOLING OIL PUMP
MAIN LUBE OIL PUMP
COMMON SUCTION PIPE
STRAINER HOUSING
LUBE OIL COOLER
OIL PRESSURE RELIEF VALVE (125 PSI)
MICHIANA FILTER TANK
BYPASS VALVE 40 PSI

LUBE OIL SYSTEM

Lubricating of Oil system in WDG4/WDP4 consists of the following:

1. Engine sump
2. Scavenging oil pump
3. Lube oil filter tank
4. Lube oil cooler
5. Lube oil strainer
6. Main Lube oil and piston cooling oil pump
7. Soak back oil pump
8. Oil separator and
9. Hot oil detector

1.Engine Sump: Engine sump in WDG4 is an extended type sump to help this locomotive to extend the periodicity of the schedule. Total oil capacity of lube oil system in WDG4 is 1457 liters and the difference between high mark and low mark of dipstick is 600 liters. Each line is 25 liters. Dipstick is provided on both banks.

High mark to low mark in WDP4 is 167 liters and each dot is 16.7 liters lube oil dipstick is provided on the right bank of the engine.

2. Scavenging oil pump: Scavenging oil pump is a gear type pump and driven by engine crank shaft and is mounted at the right free end side of the engine block. Scavenging pump draws oil from engine sump through a coarse mesh strainer (single element) where lube oil is filtered and pumps lube oil filter tank, which is placed horizontally on engine equipment rack.

3. Lube oil filter tank: Lube oil filter consists of 5 paper type filter elements which filters engine lube oil and oil is forced to lube oil cooler. A filter tank bye-pass valve is provided across the fuel tank, but directly mounted on the filter tank which is set to 40 PSI to bye-pass the oil from filter tank whenever the filters are clogged when the difference of pressure reaches 40 PSI differential pressure gauge is provided parallel to Bye-pass valve across the filter tank which indicates the lube filters condition in the filter tank. The gauge is marked with green and red zones needle. In green zone indicates the filters in the filter tank are in good condition and needle is red zone indicates that the bye-pass valve is opened the filters need to be changed.

4.Lube oil cooler: Oil from filter tank enters the lube oil cooler which is placed inclined on engine equipment rack above the filter tank lube oil is cooled by the water and it enters the lube oil strainer.

5. Lube oil strainer: Oil from the lube oil cooler enters the lube oil strainer housing which is having of fine mesh strainer elements where the final filtration being done. Then oil enters to piston cooling or pump and main lube oil pump.

6. Main lube oil pump and Piston cooling oil pump: A seimazed oil pump which is located at the left end side of the loco consists a main lube oil pumps and piston oil pump i.e., Twin pump in one housing.

a) Main lube oil system: Oil from main lube oil pump enters main lube oil manifold is a pipeline through out the length of the engine block located above the crank shaft. A lube oil pressure relief valve is provided at the beginning of main lube oil manifold which is set to 120 PSI. A branch line is taken from the entry of main lube oil manifold to lubricate the free end gear train and stub shafts. Lube oil from main lube oil manifold is taken to individual main bearings through oil tubes to the upper half of the main crank shaft bearings.

Drilled passages in the crank shafts supplies the oil to the connecting rod bearings, tort ional damper and accessory drive gear at the front of the crank shaft, leak off oil from adjacent main bearings lubricates the crank shaft thrust bearings.

Oil from the manifold at the power take off (Generator end) end enters the gear train and lubricates all gear train stub shaft and gears.

Two oil passages are taken to both bank cam shaft drive gear stub shafts and oil enters to the drilled passages of the cam shafts. From the cam shafts drilled through passages oil lubricates all crank shaft bush bearings and then enters to valve lever mechanism through a oil pipe line connected between each cam bush and valve lever shaft, oil from the valve lever shaft lubricates rocker arm bushings, valves, springs and lash adjusters and returns to sump.

A passage from general end oil manifold is taken to Turbo charger oil filter. Filtered oil from the Turbo oil filter enters the turbo charger oil system to lubricates the ideal gears, stub shafts and Turbo.

One passage is taken to Governor loco lube oil button. Hot oil detector and EPD (engine protecting device) oil pressure in the lube oil system 8 to 12 PSI in ideal and a minimum of 25 to 29 PSI at full speed.

A hot oil detector which is set 255 deg F senses continuously the engine lube oil temperature and shuts the engine whenever the engine oil temperature 255°F through Wood Ward Governor and the locomotive will display the cause of the engine 'SHUT DOWN'.

b) Piston cooling oil system: The system cooling oil pump receives oil from the common section with main lube oil pump and delivers oil two piston cooling oil manifold extending the length the engine on each bank. A piston cooling oil pump at each cylinder directs a stream of oil the piston crown to cool the underneath piston and the ring belt, piston pin bearing and drains back to sump.

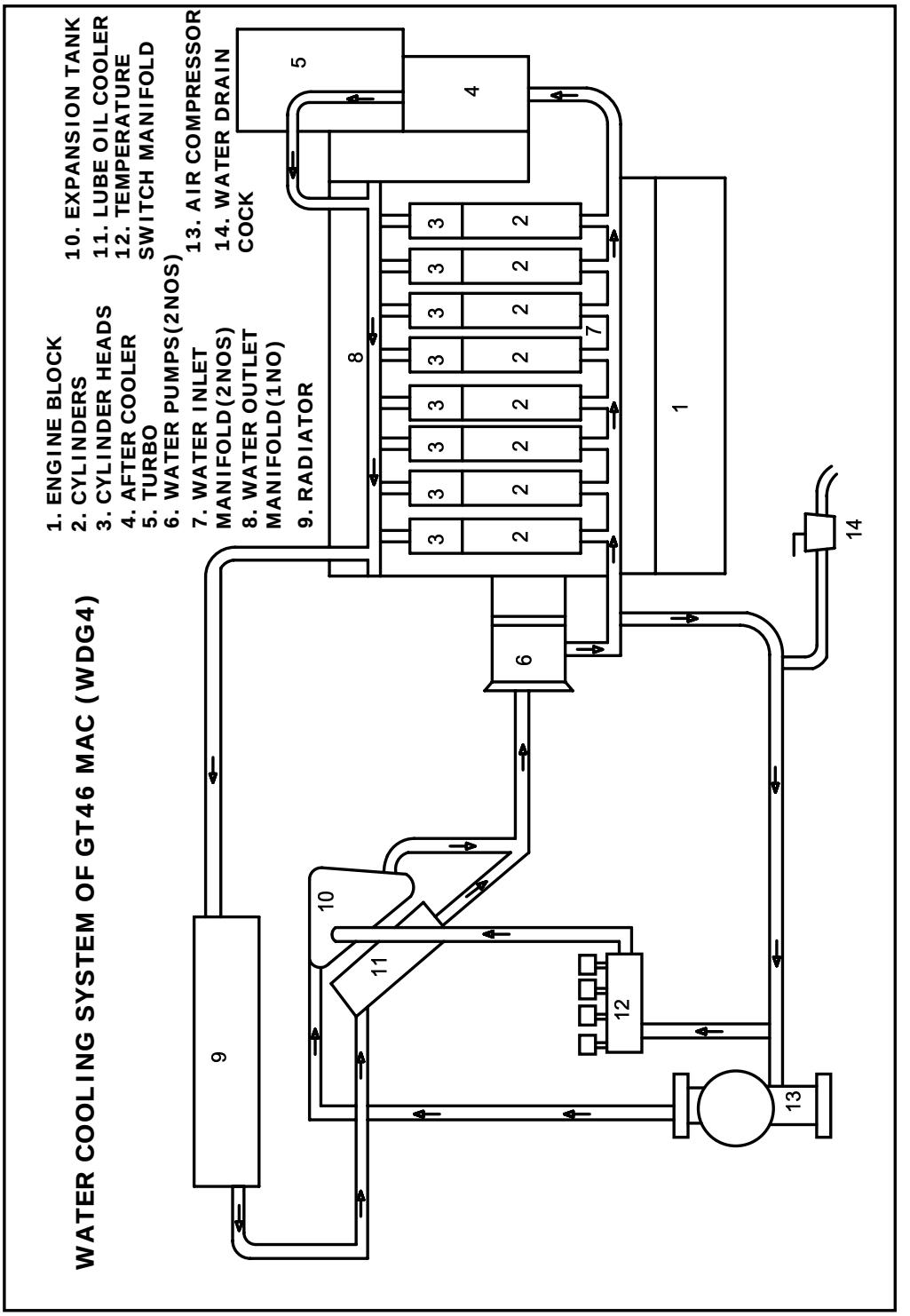
7. Soak Back Oil Pump: To ensure lubrication of Turbo charger bearings prior to engine start and the removal of residual heat from the turbo after engine shut down. A separate lube oil pump called SOAK BACK OIL PUMP is provided which is driven by a electrically operated motor indirectly controlled by locomotive main computer. The Soak Back Pump draws oil directly from the engine sump through a soak back filter and then supplies oil to Turbo through turbo filter element.

This Soak Back pump automatically starts working whenever all the circuit breaker, turbo and main computer breaker input on.

This pump works for 15 minutes before starting the engine to lubricate the turbo bearings before cranking the engine since turbo starts working at a speed of approximately 3400 RPM immediately after cranking. To avoid damages to the Turbo bearings this pump starts working to lubricate.

This pump works automatically for 35 minutes maximum after shutting down the engine to take out the heat remained in the turbo bearings after working to avoid thermal stressing and wear in the bearings. A 55 PSI pressure relief valve located in the head of the turbo oil filter controls the turbo system pressure. A by pass valve of 70 PSI is also provided across the Turbo filter to supply oil to turbo incase of filter choke.

8. Lube oil separator: The engine crank is vacuum created by the turbo exhaust gas with the help of an educator tube in this locomotive, the educator tube exhaust stack creates suction in the engine crank case and maintain crank case vacuum. While doing so it draws some oil which will be collected in dome is called lube oil separator which collects the oil and drops back to sump. The lube oil separator is provided at left generator end of the engine near turbo.


WATER COOLING SYSTEM OF GT46 MAC (WDG4)
1. ENGINE BLOCK
2. CYLINDERS
3. CYLINDER HEADS
4. AFTER COOLER
5. TURBO
6. WATER PUMPS(2NOS)
7. WATER INLET MANIFOLD(2NOS)
8. WATER OUTLET MANIFOLD(1NO)
9. RADIATOR
10. EXPANSION TANK
11. LUBE OIL COOLER
12. TEMPERATURE SWITCH MANIFOLD
13. AIR COMPRESSOR
14. WATER DRAIN COCK

COOLING WATER SYSTEM

Cooling water system in WDG4 & WDP 4 locomotive is a pressurized closed loop cooling water system. Water from the expansion tank and the lob oil cooler is drawn by two centrifugal pumps, mounted free end side of the engine on both banks. Both water pumps are gear driven by the engine.

These pumps, pumps the water in to water in let manifold on either bank of the engine by respective pump. Water from the water inlet manifold is taken to individual cylinder liner water jackets through water inlet tubes.

Water circulated surround the cylinder liner water jacket is pumped to individual cylinder heads through 12 internal holes. After cooling the combustion chamber of the cylinder liner and water jacket in the cylinder head, water piped to water discharge manifold through discharge or outlet elbow from each cylinder head.

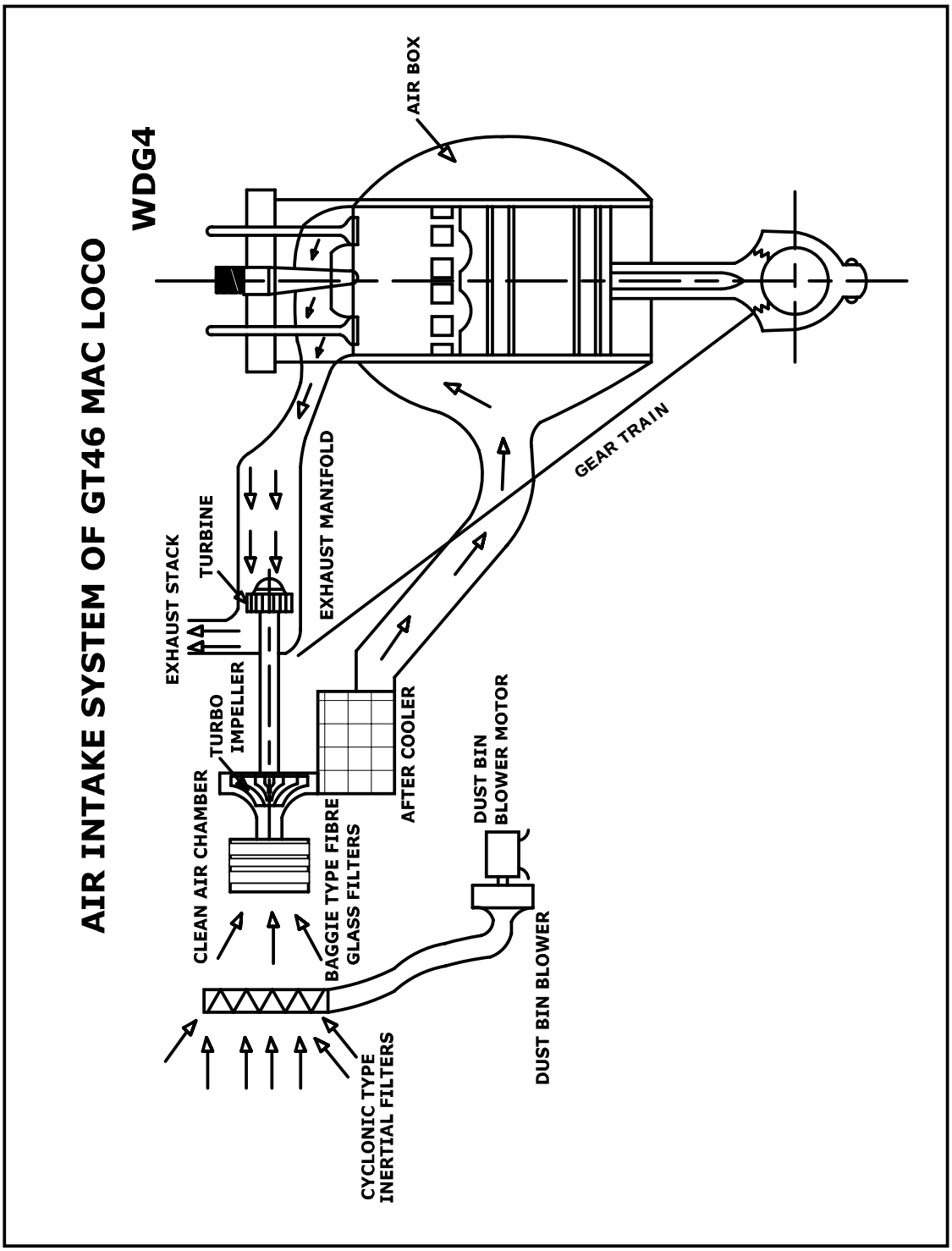
Water from both bank water inlet manifold is also taken to both bank after coolers at the power take off end. After circulating in the after cooler water is piped to discharge manifold from both after coolers. Water from discharge manifold is divided in to two ways and directed to both side radiators, through water discharge "Y" pipe.

Two heavy duty radiators are provided on top of radiator compartment of either sides. Two AC motor driven radiator fan cools the hot water in the radiation by the fans which are provided underneath the radiators. These fans are controlled by locomotive computer which logically operates each fan at two different speeds (Slow and High speed) according to the requirement in order to control the engine temperature with in the range of normal operating temperature of 80 to 85 deg centigrade.

Water from both radiators will enter lube oil cooler which is provided on engine equipment rack and cools the engine lube oil and then the outlet of lube oil cooler joins with the water expansion tank outlet and these outlets are connected to both bank water pump and the circulation cycle continues in the system. The expansion tank is placed on the top of lube oil cooler on engine equipment rack. A water level indicating glass tube is provided by the side of water expansion tank to monitor the water level in the expansion tank in engine DEAD/RUN. Water level should be maintained near to full mark. The pipe line from both water pumps outlet is taken to air compressor which is a water cooled type compressor. Water enters the air compressor cylinder liner jackets, circulates through liner & cylinder head, inter cooler and cools the compressed air and then returns back to water expansion tank.

Two engine temperature probes are provided on engine left bank water pump inlet header to sense the water temperature to give feed back to locomotive computer. Based on the feed back computer logically operates either one of both the fans at slow or full speed according to the requirement. When ever the engine temperature is not controlled due to non working of radiator fans or any other problem in cooling water system the computer will display 'HOT ENGINE- THROTTLE-6 limit'

Computer automatically limits the power to sixth notch only though the throttle handle is in 7th of 8 notch. When the temperature is reduced this message will disappear and full power will be obtained automatically.


AIR INTAKE SYSTEM OF GT46 MAC LOCO
WDG4
AIR BOX
GEAR TRAIN
EXHAUST MANIFOLD
TURBINE
EXHAUST STACK
TURBO IMPELLER
AFTER COOLER
DUST BIN BLOWER MOTOR
CLEAN AIR CHAMBER
BAGGIE TYPE FIBRE GLASS FILTERS
DUST BIN BLOWER
CYCLONIC TYPE INERTIAL FILTERS

AIR INTAKE SYSTEM

Diesel Engine in WDG4/WDP4 locomotive is a super charged fuel-efficient and two stroke engine. Since the locomotive is provided with two-stroke engine, the inlet air requirement for proper combustion of the fuel is high. To fulfill the requirement of the engine a special turbo super charger is provided in this locomotive to supply required quantum of air in each notch according to load and speed condition.

Air intake system is dividing in the following steps.

1. Inertial air intake/cyclonic type air intake filters
2. Clean air chamber
3. Baggy type engine air intake secondary filters.
4. Turbo super charger.
5. After coolers.
6. Air boxes.

1. **Cyclonic Filters**; -

Air from the atmosphere is taken into cyclonic filters provided on both sides of the locomotive out side the clean air chamber. AC motor driven dustbin blower creates partial vacuum in clean air chamber and draws air from the atmosphere. The dust, dirt and suspended particles in the drawn air will be expelled out by centrifugal action created by inertial/cyclonic filters. Pure filtered air will be taken inside clean air chamber and dustbin blower will pump the dust and dirt out down the locomotive.

2. Clean air chamber;-

Air from the clean air chamber is further utilized for the following.

a) The diesel engine through secondary air intake baggy filters.
b) For cooling of all six traction motors and main alternator by Tm blower and for the air compressor air intake.
c) Air is taken to cool both the TCC's through TCC electronic blower.
d) Compressed air is taken to pressurize electrical control cabinet to protect components from entry of dust.

3.Baggy Type Engine Air intake Filter

Air from the clean air chamber is drawn by turbo through engine mounted baggie type secondary air intake filters, which further filters the intake air for the engine, and clean air is pumped to engine air boxes by turbo charger.

4.Turbo Charger; -

The turbo charger is basically provided to increase the engine horsepower output to it maximum extent and provide better fuel economy. The turbo charger provided in this locomotive is of a special type single stage turbine, which maintain constant air to fuel ratio through out the engine operation.

At the beginning stage turbo is directly driven by the engine through a gear train approximately with gear ratio of 1:18 and after reaching 6th notch in load, turbo mechanical drive will be disengaged by over riding clutch since the energy in exhaust gases from the engine is sufficient to drive the turbo. Air then is compressed by the turbo impeller and is directed to after coolers through diffuser casing.

5. After Coolers: -

Two after cooler are provided in this locomotive one on either bank of engine. After cooler is water-cooled type to take out heat from the compressed engine intake air to supply high dense air for complete combustion of the fuel in combustion chamber. The water for after cooler is taken from the engine cooling water system.

6. Air Boxes: -

Air boxes are provided one on each bank of the engine to supply the high dense clean air for the engine requirement. Air from the air box is taken into individual cylinder through cylinder liner port openings during suction stroke when piston uncovers the inlet force.

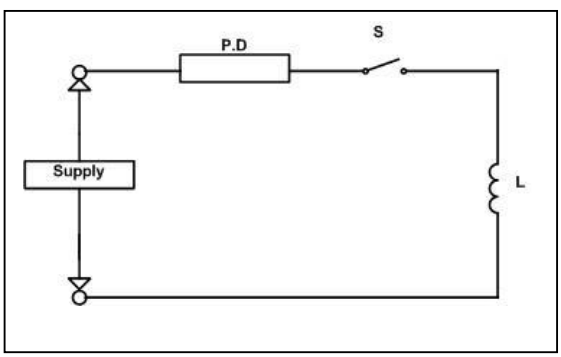
The huge air box on either side of the engine helps to cool the cylinder continuously since the compressed and after cooled air is surrounded the cylinders. A common drain from both bank air boxes is provided down in between two trucks, which drains. The water or oil, which is collected in the air boxes. Drivers or crew are required to see this air box drain pipe and report to shed if they found water traces which is the symptom of water leakage in the air intake system.

ELECTRICAL

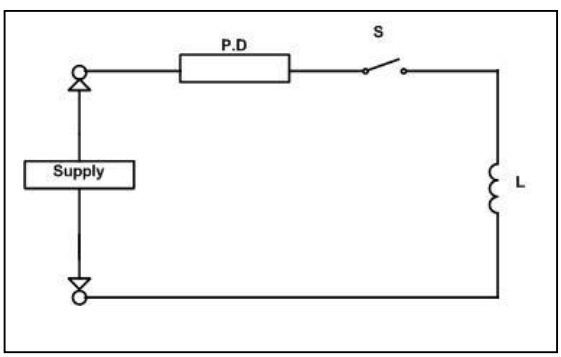
FUNDAMENTALS OF ELECTRICITY

ELECTRICITY IS A GOOD SERVANT BUT, WHEN IT BECOMES MASTER IT TREATS YOU VERY CRUELLY.

ELECTRICITY	Electricity is one form of energy which can be experienced in its applications
ELECTROMOTIVE FORCE	The electrical force which gets the electrons in motion is called 'ELECTROMOTIVE FORCE' (E.M.F). The measuring instrument is called Voltmeter. It is measured in volts and is denoted by letter 'V'.
CURRENT	Current is flow of electrons. The measuring instrument is called Ammeter. It is measured in Amperes and is denoted by Letter 'A'
RESISTANCE	The natural property of a substance which opposes the flow of current through it, is called 'Resistance'. The measuring instrument is called Ohmmeter. It is measured in OHMS and is denoted by letter Ω.
CONDUCTOR	It is a substance that readily allows current to flow through it. **Ex :** Silver, Copper, Nickel, Aluminum, iron etc.
INSULATOR	It is a substance that does not allow the current to flow through it. Insulating Resistance is measured with Megger and Unit is Mega ohms. **Ex :** Mica, Rubber, Porcelain, Plastic, Glass etc…
CIRCUIT	A conducting path for electric current is called a circuit
OPEN CIRCUIT	It is one in which there is no flow of current.



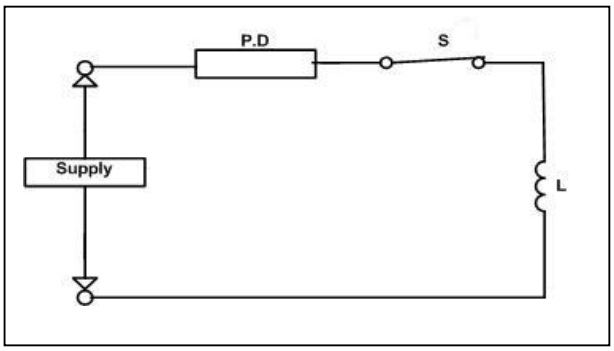
Circuit



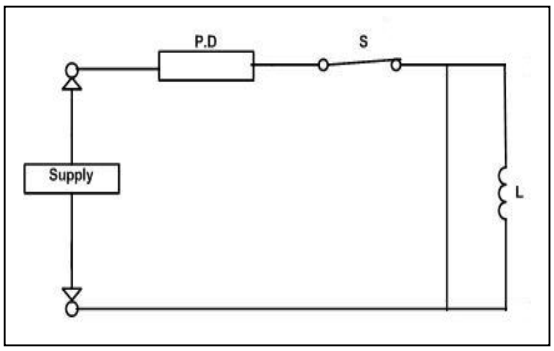
Open Circuit

PD : Protecting Device
S : Controlling Device
L : Load

CLOSED CIRCUIT	It is a circuit in which the current flows continuously. **Advantage**: Make to work the load with power supply.
SHORT CIRCUIT	In this circuit the maximum amount of current is by passed through shorting. **Disadvantage :** 1. Load will not work. 2. If, protecting device is there, it is going to trip. 3. If protecting device is not there, total circuit will get burnt.



Closed Circuit



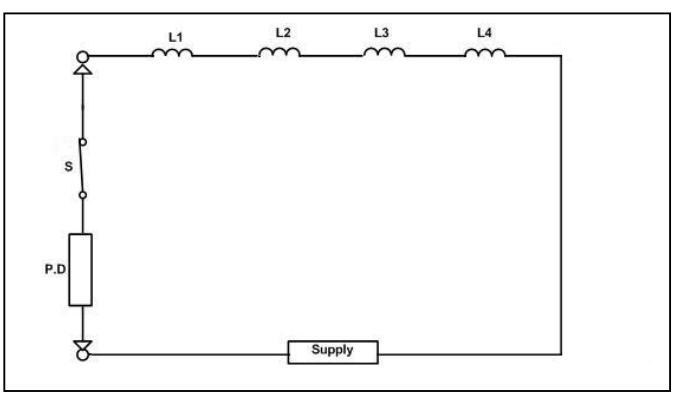
Short Circuit

Types of closed circuits :

There are three types of closed circuits.

1. Series circuit
2. Parallel Circuit
3. Compound circuit (Series and Parallel circuit)

1. Series Circuit : It is a circuit in which there is only one path for the conduction of current. (or) Several resistances are joined in such a way is called series circuit.



$R = R_1 + R_2 + R_3 + R_4$

$V = V_1 + V_2 + V_3 + V_4$

$I = I_1 = I_2 = I_3 = I_4$

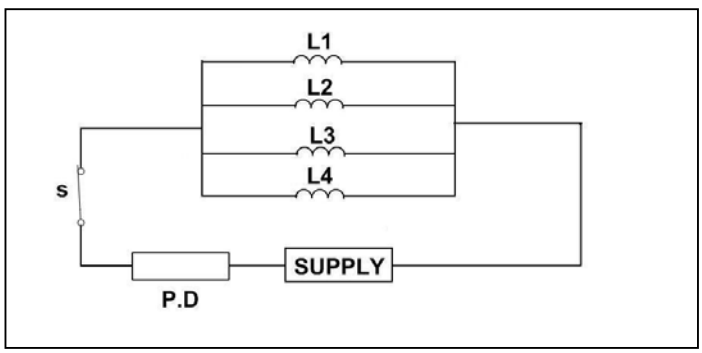
The main characteristics of a series circuit are: -

1. Same current flows through all parts of circuits.
2. Different resistors have their individual voltage drops.
3. Voltage drops are additive.
4. Applied voltage is equal to sum of different voltages.
5. Resistances are additive.
6. Powers are additive.

Disadvantage: If any open circuit takes place anywhere complete circuit will be open and there will not be any flow of current. (Total Off).

Advantage: We can make 6 volts bulbs to glow in 240 volts supply by making 40 bulbs in series.

2. Parallel Circuit: It is that in which all the resistances are connected across a source of supply (or) several resistances are joined in such a way to supply.



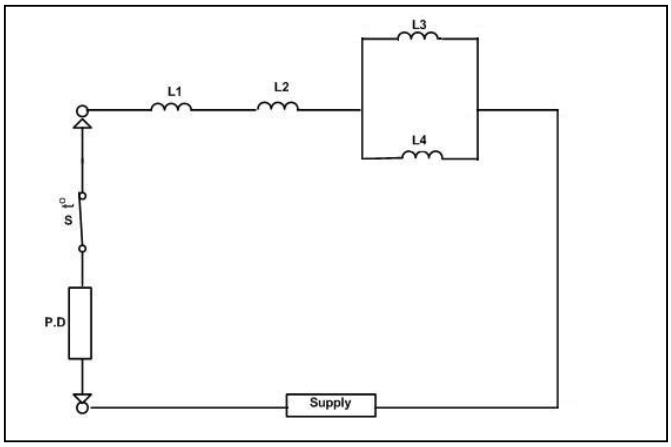
The main characteristics are: -

1. Same voltage across all parts of the circuits.
2. Different resistors have their individual currents.
3. Branch currents are additive
4. Conductance are additive.
5. Powers are additive.

Advantage: If any open circuit takes place anywhere, the particular circuit only will be affected. Other circuits are going to work normal.

Disadvantage: It is not possible to make 6 volts bulbs in 240 volts by making 40 bulbs in parallel.

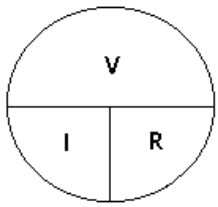
3. Compound Circuit: A compound circuit is the combination of series and parallel circuits and characteristics also same like series and parallel.



OHMS LAW : In any closed circuit the current is directly proportional to the voltage and inversely proportional to the resistance. When the temperature is being constant.

V =I x R (POWER) P = V x I= VI watts
I =V / R
R =V / I

V – VOLTAGE I - CURRENT R – RESISTANCE.



Effects of Current :

1. Magnetic Effect : Ex. Motors and generators.
2. Heating Effect : Ex. Bulbs, heater etc.
3. Chemical Effect : Ex. Cells, electroplating etc.
4. Physiology or Physical Effect. : Ex. Shocking

TYPES OF POWER SUPPLY

In Electricity there are two types of power supply is available.

1. Direct current(D.C): If generator having Commutator, it is going to produce DC current.
2. Alternating Current (DC): If generator is having slip rings or with out slip rings, it is going to produce AC current. AC can be converted into DC by rectifiers (Bridge rectifiers)

BATTERIES

Cell : It is a device in which the chemical energy is converted into electrical energy.

Cells are classified into two types.

1. Primary Cells
2. Secondary Cells

1. Primary Cells : Once discharged it cannot be recharged.
ex. Dry cells.

2. Secondary Cells : These can be recharged after discharge any No. of times.
ex. Lead acid Cells, alkaline cells.

Battery : A group of cells are called Battery.

Functions of Batteries :

1. To work as stand by power source in absence of electrical supply.
2. It is used for lighting.
3. It is used for starting of the automobile engines.

DC GENERATORS

Generator is a machine which converts mechanical energy into electrical energy.

Principle :

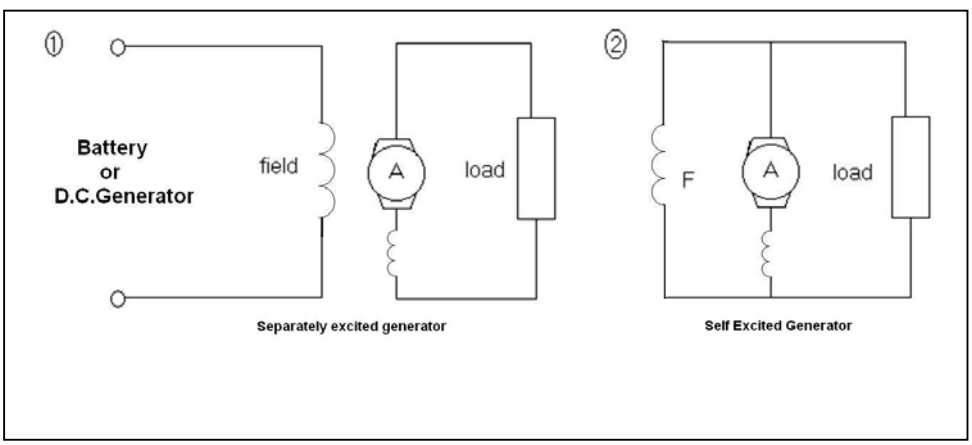
Whenever a conductor cuts the magnetic lines of force an EMF is induced in it or vice-versa.

If any D.C. machine wants to work as a generator the following things are required.

1. Field (Magnetic field).
2. Armature (conductor).
3. Prime mover.

In generators mainly there are two types. They are

1. Separately excited generator.
2. Self excited generator.



1. **Separately excited generator :**

   (a) Field coils are going to get electrical power from other sources like battery or any other generator.

   (b) Permanent magnets are used for magnetic field

2. **Self Excited Generator:** Field coils are getting current from its own armature.

D.C. MOTOR

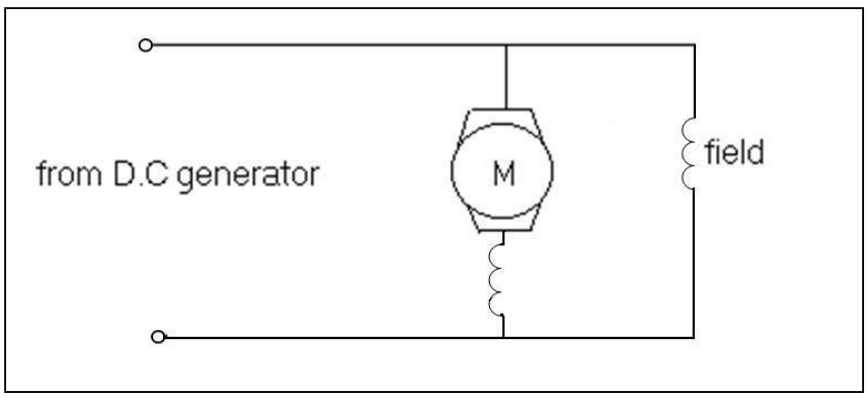
Motor is a machine, which converts electrical energy into mechanical energy.

Principle :

Whenever current carrying conductor is placed in the magnetic field the conductor tends to move.

If any D.C. machine wants to work as a motor the following things are required.

1. Field (Magnetic Field).
2. Armature (conductor).
3. Current to the Armature (conductor).



D.C. Motors are of 3 types

1. D.C. Series Motor
2 D.C. Shunt Motor
3 D.C. Compound Motor

1. D.C.Series Motor:

In this the field winding is in series with armature. The series motor has an excellent starting torque at low speeds and will operate at high speeds under light loads. However, it will 'run away' under no-load conditions. In our locomotive Traction Motors and BKBL are D.C. Series motors.

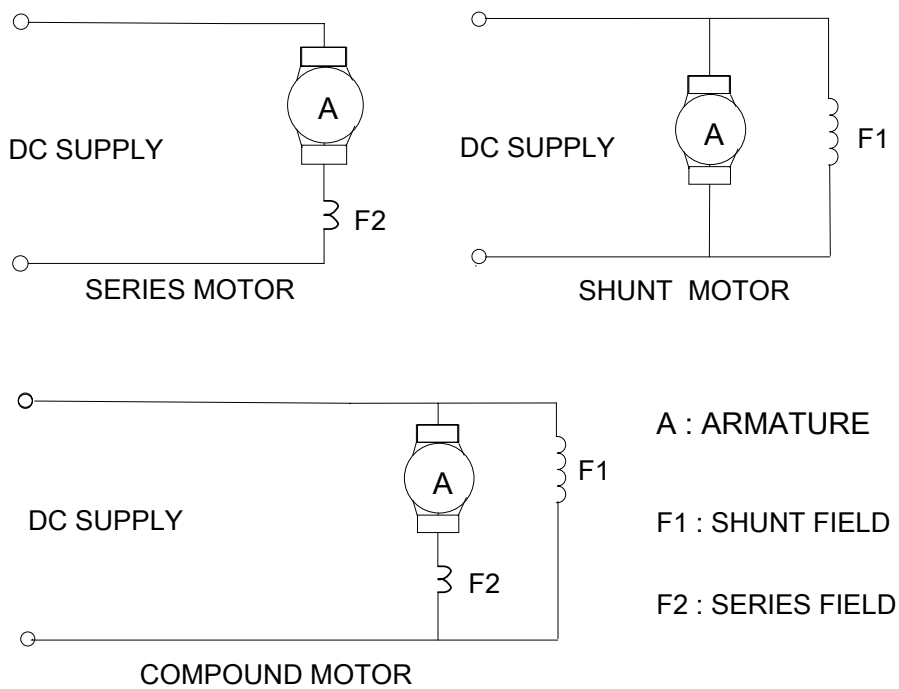
2. D.C Shunt Motor:

In this field winding is in parallel to armature. The shunt motor gives a more constant speed than the other types, however, its limited starting torque makes it useless when constant starting and stopping are required. It will not 'run away' under no load conditions.

3. D.C. Compound Motor:

It is a combination of series and shunt motor. The compound motor combines the best features of the two previous types, it has a good starting torque and will not 'run away' under no load conditions.

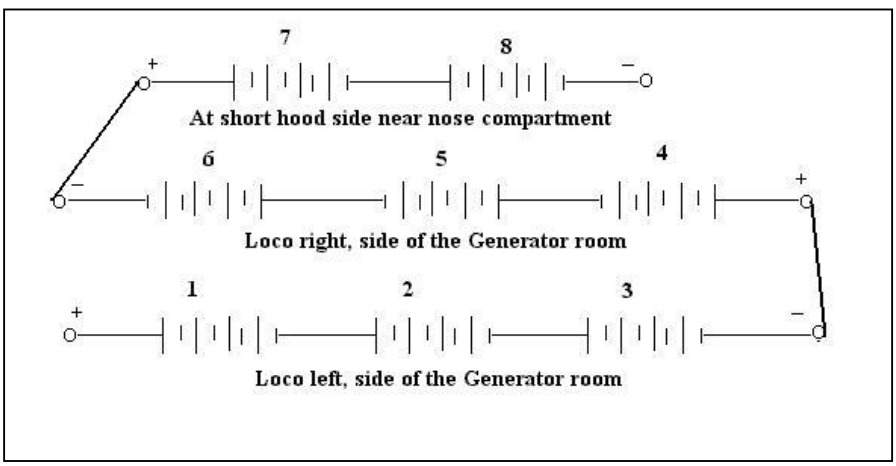
In our locomotive Fuel Pump Motor (FPM) , Crank Case Exhauster Motor (CCEM) and Dust Exhauster Motors are D.C. Compound Motors.



LOCOMOTIVE BATTERIES

In a locomotive there are 8 batteries and in each battery there are 4 cells.

Total cells in the locomotive is 8 X 4 = 32.
Each cell voltage is 2.2 volts. (Fully charged)
Each battery voltage is 2.2 X 4 = 8.8 volts.
Total batteries voltage is 2.2 X 32 = 70.4 volts.
Total Batteries Capacity = 450 ampere hours



Location:

No. 1,2 & 3 batteries are located in battery box which are kept left side of the loco near generator room.

No. 4,5 & 6 batteries are located in battery box which are kept right side of the loco near generator room

No. 7 & 8 batteries are located in battery box, which are kept at right side of the loco near nose compartment .

Purpose :

1. In engine shut down condition batteries will give supply for all the control circuits.
2. During engine starting batteries will give supply to the main generator to work as a motor to crank the diesel engine.
3. During engine running if auxiliary generator fails batteries will supply for all the control circuits for 4 hours to run the locomotive in normal working.

Batteries are getting charging from auxiliary generator. The batteries charging and discharging can be known by battery ammeter. It is located on Front Panel.

CHARGING:

If Battery ammeter is showing below 10 Amps in charging side continuously then battery charging system is in normal.

DISCHARGING:

If Battery ammeter showing towards discharge side (more than 1 amp)

Reasons: a) Auxiliary Generator may be failed.
b) VRP may be failed (maintaining '0' or below Battery Voltage)
c) BX-BN cards in VRP may be slack.
d) VRP fuse may be blown
c) AGFB may be tripped

If it is not possible to rectify, work normal for 4 hours following the precautions of Engine should not be shutdown or should not allow for automatic shutdown.

Over Charging:

If Battery Ammeter is showing more than 20 amps in charging side continuously, then Batteries are getting overcharging.

Reasons:
a) VRP may be defective (may be maintaining more than rated voltage 72 V ± 1)
b) Batteries may be defective. (may be less electrolyte or may be any where short circuit in battery system)

Battery Ammeter Zero:

If Battery Ammeter is showing '0' then it is going to be called Batteries are not getting charged or not getting discharged.

Reasons:
a) MB1 may be tripped or in OFF condition
b) Battery Knife Switch (BS) may be in open condition
c) Batteries internal connections may be open circuited

COMPONENT SYMBOL AND ITS DESCRIPTION

SL.NO	NAME OF THE COMPONENT	SYMBOL	LOCATION
01	Armature current control resistor	ACCR	Front panel
02	Auxiliary Generator Field Breaker	AGFB	Front Panel
03	Alarm Gong (Bell)	ALG	Front Panel
04	Battery Ammeter	BA	Front panel
05	Battery Ammeter Shunt	BAS	Front Panel
06	Battery Discharge Lamp Indication	BDL	Front panel
07	Braking Relay	BKR	Front Panel
08	Braking Grids	BKG	Nose Compartment
09	Braking Transfer Switch	BKT	Front panel
10	Braking Blower Motor	BKBL	Nose Compartment
11	Braking Isolation Valve	BKIV	S/H Control stand
12	Battery Knife Switch	BS	Nose Compartment
13	Cranking Contactors	CK1,CK2	Front Panel
14	Crank Case Exhauster Breaker	CCEB	Front panel
15	Crank Case Exhaust Motor	CCEM	Engine Room
16	"C" Relay Valve	CVR	Front Panel
17	Dead Man's Relay	DMR	Front Panel
18	Doom Light Control Breaker	DLC	Front panel
19	Dust Exhauster Motor	DEM	Under chassis both sides of radiator room
20	Dust Exhauster Breaker	DEB	Front panel
21	Engine Front Panel	ECP	Front Panel
22	Engine Control Switch	ECS	Front Panel
23	Engine Speed Relays	ESR1,2,3,4.	Front Panel
24	Engine Run Relay	ERR	Front Panel
25	Engine Temperature Switch	ETS	Expressor Room
26	Engine Start Lamp Indication	ESLP	Front panel
27	Fuel Pump Contactor	FPC	Front Panel
28	Fuel Pump Breaker	FPB	Front panel
29	Field Shunt Contactors	FS21-26	Back Panel
30	Field Shunt Relay	FSR	Front Panel
31	Field Shunt Relay Resistance	FSRR	Back Panel
32	Generator Field Contactor	GFC	Front Panel
33	Generator Field Cut Out Switch	GFCO	Both control stands
34	Ground Relay	GR	Front panel
35	Ground Relay Cut Out Switch	GRCO	Front Panel
36	Generator Field Over Load Relay	GFOLR	Front Panel

SL.NO	NAME OF THE COMPONENT	SYMBOL	LOCATION
37	Head Light Breaker	HLB	Front panel
38	Head Light Converter	HLC	Back Panel or Dr's cab
39	Load Ammeter	LA	Control Stands (Both)
40	Load Ammeter Shunt	LAS	Front panel
41	Load Control Rheostat	LCR	Inside Governor
42	Low Water Switch	LWS	Expressor Room
43	Main Battery Breaker	MB1	Front panel
44	Main Control Breaker	MB2	Front panel
45	Master control Breaker	MCB	Both Control Stands
46	Master Fuel Pump Breaker	MFPB	Both Control Stands
47	Multiple Unit Shut Down Switch	MUSD	Both Control Stands
48	Radiator Fan Contactors	R1,R2	Back panel
49	Parallel Power Contactors	P1,P21,P31 P2,P22,P32	Front Panel
50	Pneumatic Control Switches	PCS	Near AFL Unit
51	Reverse Current Diode	RCD	Front Panel
52	Eddy Current Clutch	ECC	Radiator Compartment
53	Reverser Switch	REV	Front panel
54	Reverser Handle	RH	Control stand
55	Series Power Contactors	S1,S21,S31	Front Panel
56	Safety Auxiliary Relay	SAR	Front Panel
57	Selector Handle	SH	Both Control stands
58	Signal Relay	SR	Front Panel
59	Transition Relay	TR	Front Panel
60	Temperature Switches	TS1 & TS2	Expressor Room
61	Transition Panel	TRP	Front Panel
62	Transition Excitation Transformer	TET	Front Panel
63	Throttle Handle	TH	Both Control stands
64	Traction Motors	TM	Under Truck
65	Time Delay Relay	TDR	Front Panel
66	Voltage Regulating Panel	VRP	Front Panel
67	Voltage Regulating Current Limiting Shunt	VRCLS	Back Panel
68	Wheel Slip Buzzer	WSB	Short Hood Control Stand
69	Wheel Slip Relay	WSR	Front Panel
70	Wheel Slip Relay Resistance	WSRR	Back Panel

ELECTRICAL ROTATING EQUIPMENTS IN LOCOMOTIVE

Main Generator : It is provided in generator room, driven by engine crank shaft and cooled by its own ARMA fan. It is a separately excited generator (field is excited by Exciter Generator)

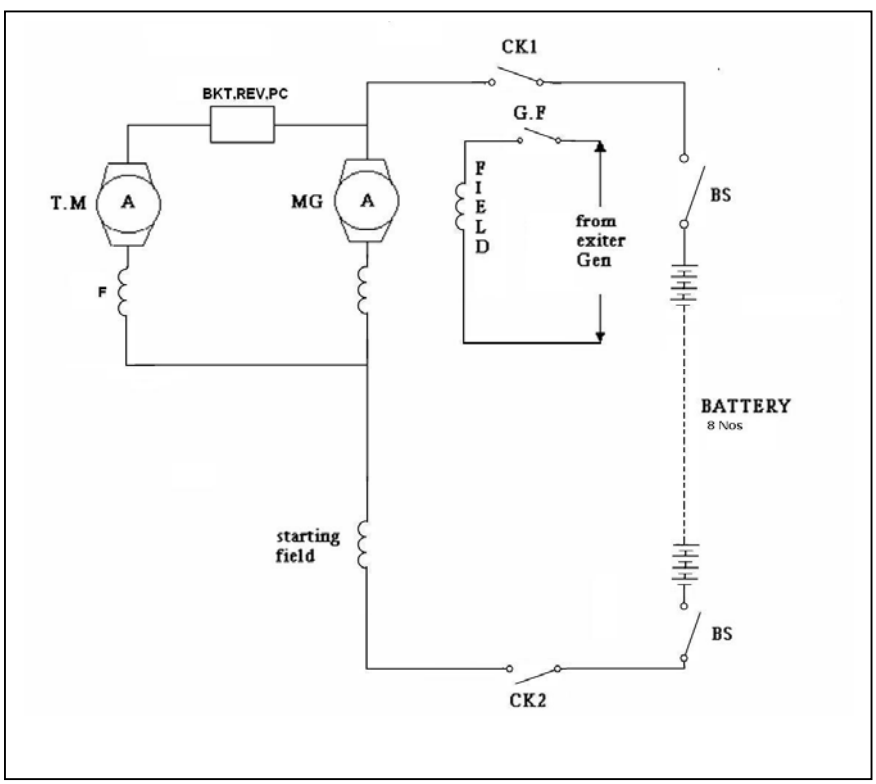
Purpose :

1. While engine starting this will work as a DC motor by taking current from the battery through cranking contactors.
2. During engine working this will work as a DC generator and induced Power will be supplied to traction motors through switch gear unit (P.C, BKT and REV).
3. During dynamic braking this will work as a DC generator and induced power will be supplied to traction motor fields for excitation.

Effects On Failure :

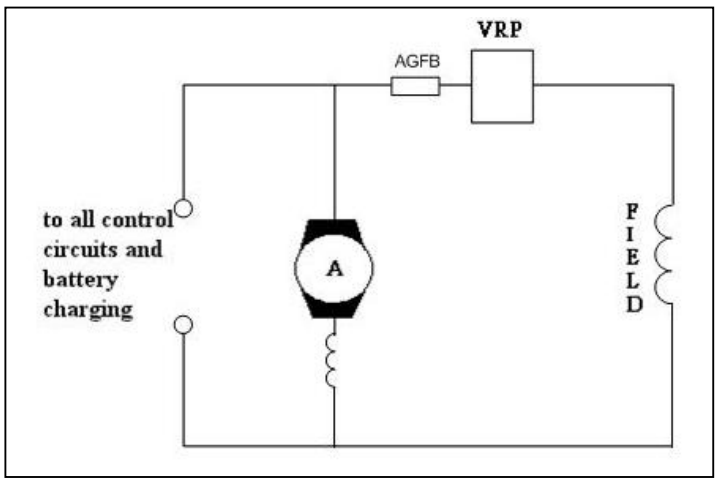
1. During engine starting it will not work as a DC motor and engine will not crank.
2. On run load ammeter will not respond (Traction Motors will not get supply).

MAIN GENERATOR (ENGINE STARTING)



Auxiliary Generator :

It is provided in generator room fitted on generator gear case. It is driven by generator bull gear. It is a self excited generator



Purpose :

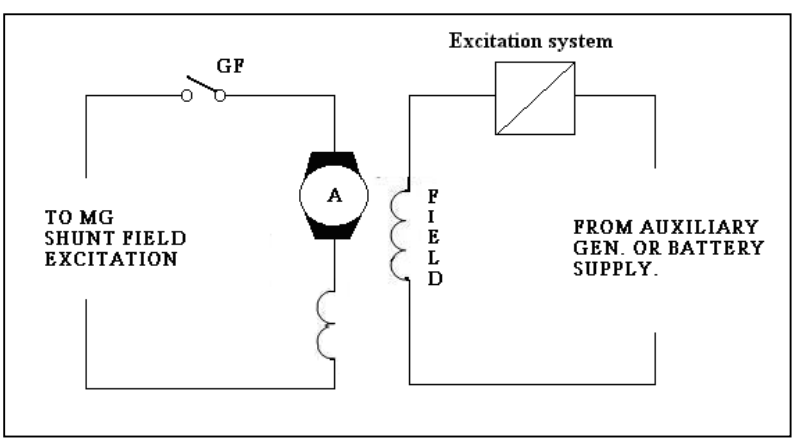
1.During working induced voltage is utilized for battery charging.
2. For all control circuits.

The field is controlled by voltage regulating panel (VRP) to get constant voltage 72 $\pm$ 1, irrespective of notch position and engine speed and field is protected by AGFB.

Effects on Failure: Battery ammeter will show discharging (Batteries and control circuits will not get power and control circuits gets current from battery)

Exciter Generator :

It is provided in generator room and is driven by generator bull gear. It is a separately excited generator. It's field is excited by Auxiliary Generator/ Battery

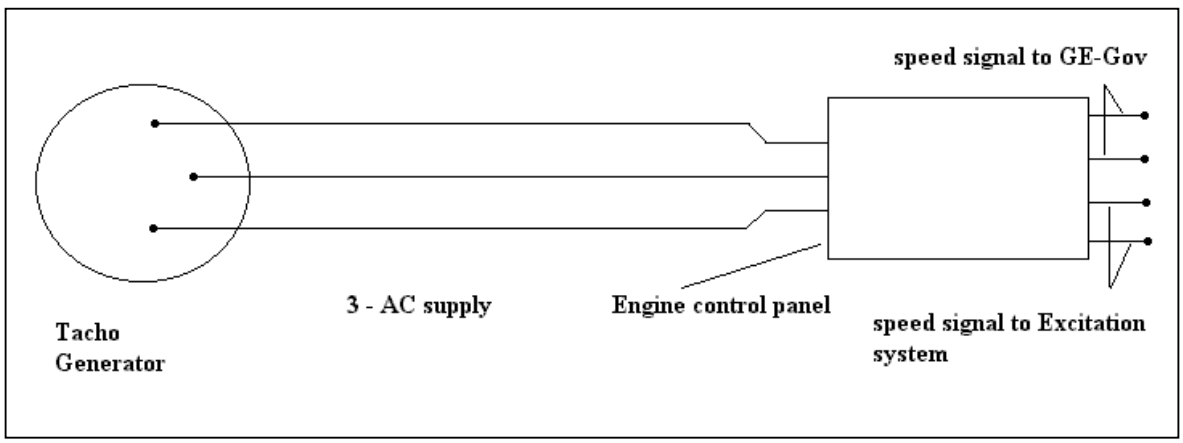


Purpose : Through GF CONTACTOR Main Generator Shunt field is excited.

Effects On Failure :
Load meter will not respond (no field excitation), no current from traction generator and no current to Traction Motor.

TACHO GENERATOR

Location : Engine right side power take off end below the governor.
Driven By : It is driven by crank shaft (through split gear, cam gear and nylon gear).
TYPE: It is a Permanent Magnet type Alternator.



GE GOVERNOR

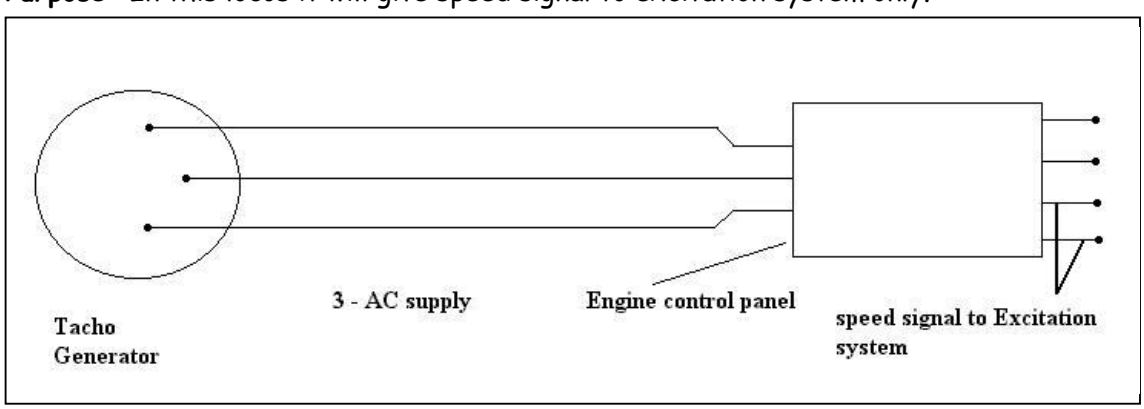
Purpose : It produces 3 phase AC supply. It sends speed signals to GE governor and excitation system through ECP.

Effect On failure : In GE Governor :

1. During engine starting engine will crank, fire, with over speed, OSTA will trip and engine comes to shut down.
2. On run engine will shutdown without indication through SAR.

In Wood Ward Governor:

Purpose : In this locos it will give speed signal to excitation system only.



WOOD WARD GOVERNOR

Effects on Failure : While engine starting no problem (Engine will crank, fire, hold and raise).

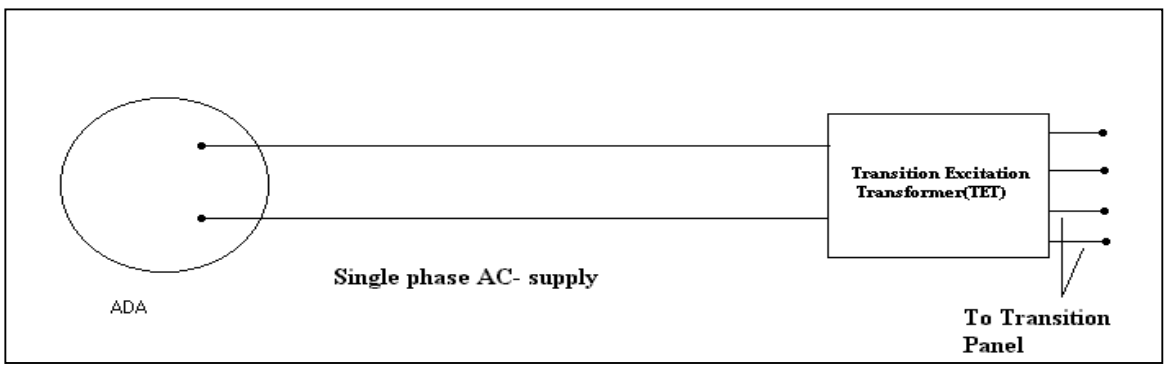
On run if it fails load meter will not respond (Load meter will drop to zero).

AXLE DRIVEN ALTERNATOR

Location : It is fitted on L2 axle.

Driven By : It is driven by axle.

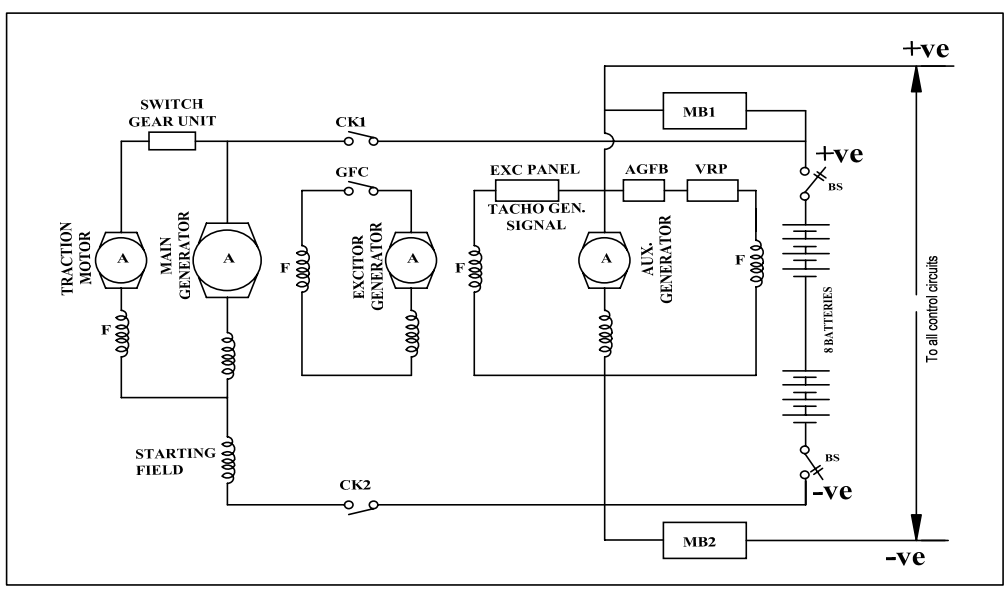
TYPE: It is Permanent Magnet type Alternator



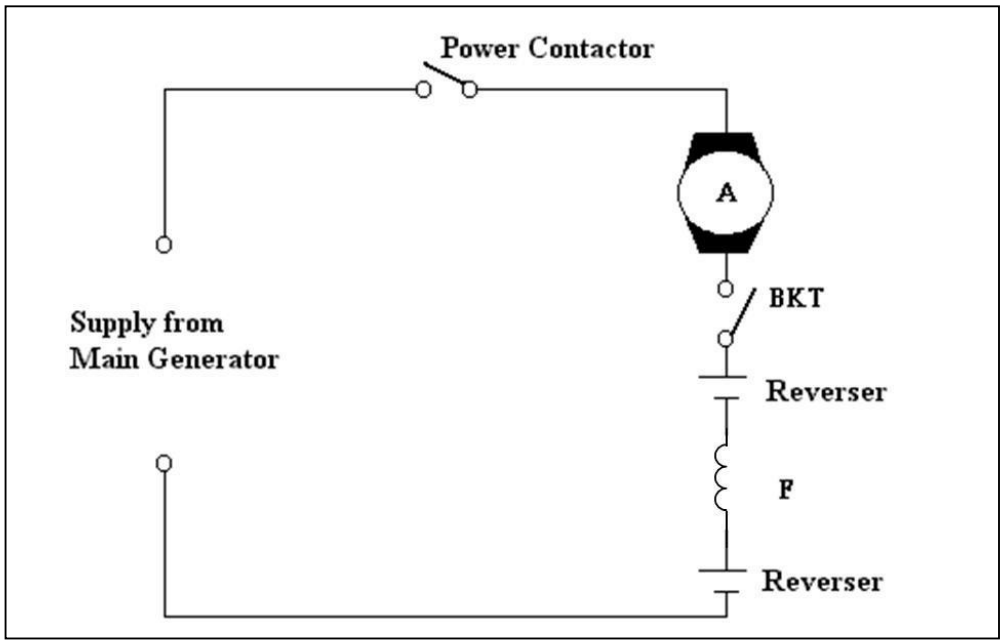
Purpose : It will give locomotive speed signal to auto transition through TET & TRP.

Effects On Failure : Auto transition will not work.

Loco can work with manual transition by taking precaution of removing all the 04 TRP cards.



TRACTION MOTOR



Location : It is suspended on the axle through the suspension bearings and rested on the bogie with resilience pad

Type: It is a D.C. Series Motor.

Purpose :

1. During motoring these motors are getting current from main generator through BKT, Reverser and Power Contactors (Switch Gear Unit) and works as motor to move the Locomotive.
2. During dynamic braking these motor fields will get excitation from main generator through switch gear unit and motors are going to work as generators by the rotation of axle (Wheels). The generated supply will be fed to dynamic brake grids.

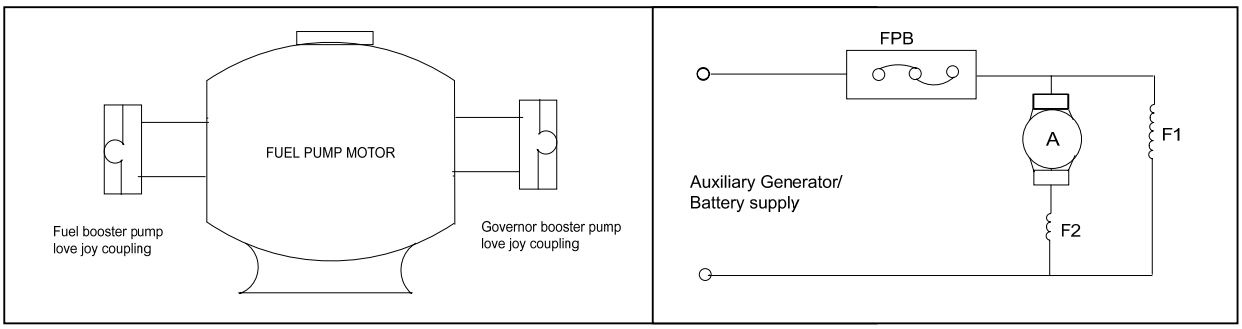
Effects On Failure :

1. If any one motor defective WSR will operate and load meter will drop to zero. We can isolate the defective motor and work further with five motors but dynamic brake effectiveness will be zero.

FUEL PUMP MOTOR

Location : Loco left side in expressor room.

Type: D.C. Compound Motor with 1 H.P.



Working : Fuel Pump Motor will gets supply from Batteries during Engine shutdown and on run from Auxiliary Generator.

Purpose :

In G.E Governor locomotives

Fuel pump motor will have two booster pumps. Towards engine side is Fuel booster pump and towards radiator room side is Governor booster pump. Both pumps are connected to motor with Love-Joy couplings.

Fuel oil is for engine working (up to FIP). Governor oil is for governor hydraulic pressure.

In Wood Ward Governor Locomotives:

Fuel pump motor will have only one pump towards engine side is fuel booster pump and this is for fuel oil pressure (up to FIP) for engine working. This is also connected with Love-Joy coupling.

Effects On Failure :

1. While engine starting if fuel pump motor is in defective engine will be cranking but firing will not take place. (Same problem even any Booster Pump failure and love-joy coupling failure)

2. While on run if fuel pump motor fails engine will come to shut down.
(Same problem even any Booster Pump failure and love-joy coupling failure)

CRANK CASE EXHAUSTER MOTOR

Location : Engine power take off end, left side opposite to governor.

Type: It is a D.C. Compound Motor with 1/3 H.P.

Working :.Crank case exhaust motor will get supply from batteries during engine shut down and on run from auxiliary generator.

Purpose :

To exhaust fumes and gasses from engine crank case and to create partial vacuum in crank case.

Effects On Failure :

Fumes and gases will not go out from engine crank case and spring loaded explosive doors will open with explosive sound and fumes and gases will go out, after pressure dropping, again doors will close automatically .

DUST EXHAUSTER MOTOR

Location : These motors are fitted only in cyclonic air filter intake system locomotives. The dust exhaust motors are fitted on both sides of the radiator room underneath on chassis of the locomotive.

Type: It is a D.C. Compound Motor.

Working :.Dust exhauster motor will get supply from batteries during engine shut down and on run from auxiliary generator.

Purpose : These motors are used to remove the dust particles, which are filtered by both cyclonic air filters.

Effects On Failure :

If motor fails, there is no effect on locomotive immediately.

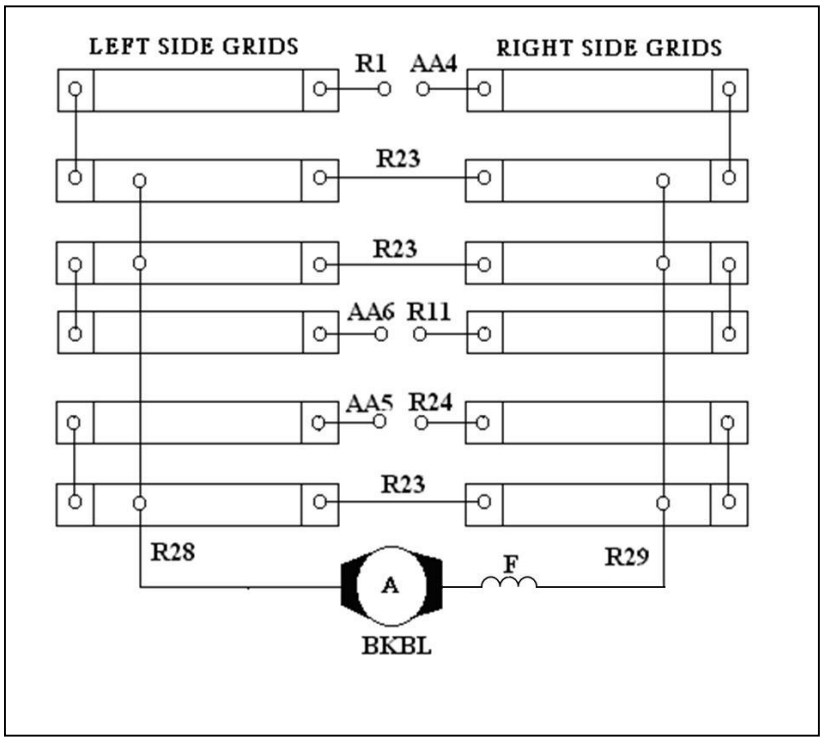
DYNAMIC BRAKE BLOWER MOTOR.

Location :

It is located in nose compartment.

Type: It is a D.C. Series Motor. (G.E. 65 H.P., B.H.E.L. 70 H.P.)

Working : It is getting current from traction motors (a part of grid current) during Dynamic Braking.



Purpose :

In running loco during dynamic braking this motor will work and drive two blowers, which are mounted on the either side of motor shaft, left side blower will cool six grids and right side blower will cool another six grids.

Effects on failure :

If it fails grids will not get cooled and there by grids are over heated and melted. Dynamic brake effectiveness will become poor.

EDDY CURRENT CLUTCH

Location : It is located in radiator room. It is fitted in between extension crank shaft (horizontal shaft) and right angle gear box. It has got two drums outer drum and inner drum. Outer drum is connected to extension crank shaft (horizontal shaft) and inner drum is connected to right angle gear box.

Working : It is getting current from auxiliary generator through R1 or R2 contactors.

Purpose : Whenever engine cooling water temperature raises 68/74 degree centigrade TS1/TS2 switches will close and R1/R2 contactors will close. E.C.C will get energized and helps radiator fan to start and engine cooling water is cooled in radiators.

Effects on failure : If E.C.C fails radiator fan will not work, there by water temperature will raise and makes to pick up ETS at 90°C. It causes Hot engine indication with alarm on the locomotive. There is no change in engine speed and also locomotive speed.

ALTERNATOR

It is a machine to generate AC supply by taking mechanical power. These types of Alternators are used in AC/DC Electrical Transmission Locomotives.

Normally in this Alternator Rotor (magnetic field) will be rotating and Stator (armature) will be stationary and it has got only two slip rings and 4 brushes.

STATOR: Induced power can be taken directly from stator easily without Commutator / slip rings and brushes.

ROTOR: Field excited from external source through slip rings / brushes, because field is rotating.

ADVANTAGES: Because of not having Commutator and brushes, problems will be very less. There will not be any copper dust and carbon dust inside the machine automatically power grounds will be minimum.

DISADVANTAGES: This alternator will not be used for engine cranking. Because machine is AC and available power in locomotive is Battery DC supply. For that auxiliary and exciter generators are used for cranking the diesel engine.

ELECTRICAL SWITCHES

Switch: Switch is an electrical control device to 'make' & break', 'on' & 'off', to open & close and energies & de-energies the circuits. There are two types of switches used in locomotives.

1.Manually operated switches

i. Knife switch
ii. Toggle Switch
iii. Push button switch
iv. Rotary switch
v. Generator field cut out switch(GFCO)
vi. Multiple unit shut down switch(MUSD)

2. Automatically operated switches

i. Pressure switch (Oil & Pneumatic)
ii. Thermal switch
iii. Floating switch

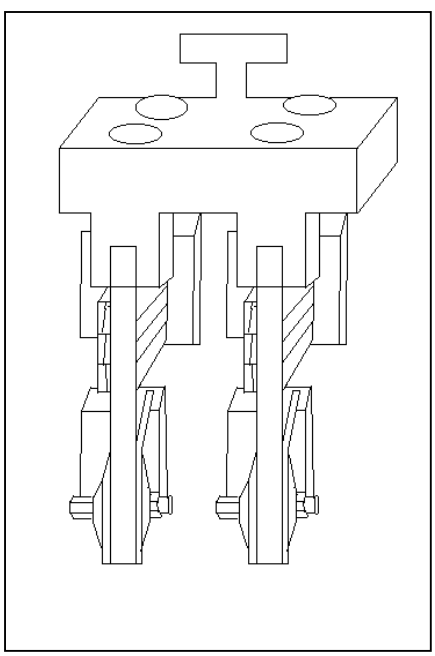
i. Knife switch : It is manually operated switch. In this there are two numbers.

a. Battery Switch(BS) :

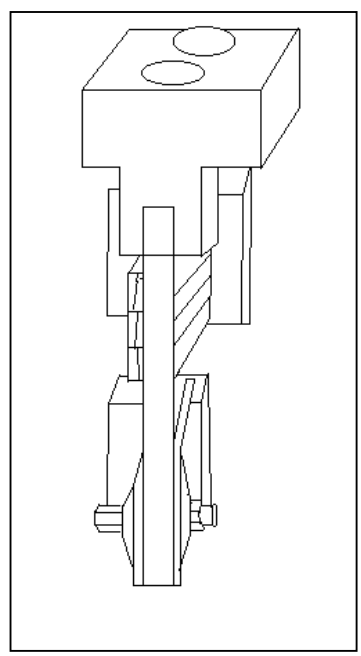
Location : It is in the nose compartment.

Purpose : Connecting battery supply to the external circuits in front panel.

If fails : a) During engine starting if it is in open Engine will not crank
b) During engine running if it is in open battery ammeter will read Zero, No problem for Engine



Battery Knife switch



G.R. Cut out switch

b. Ground relay cut out switch(GRCO):

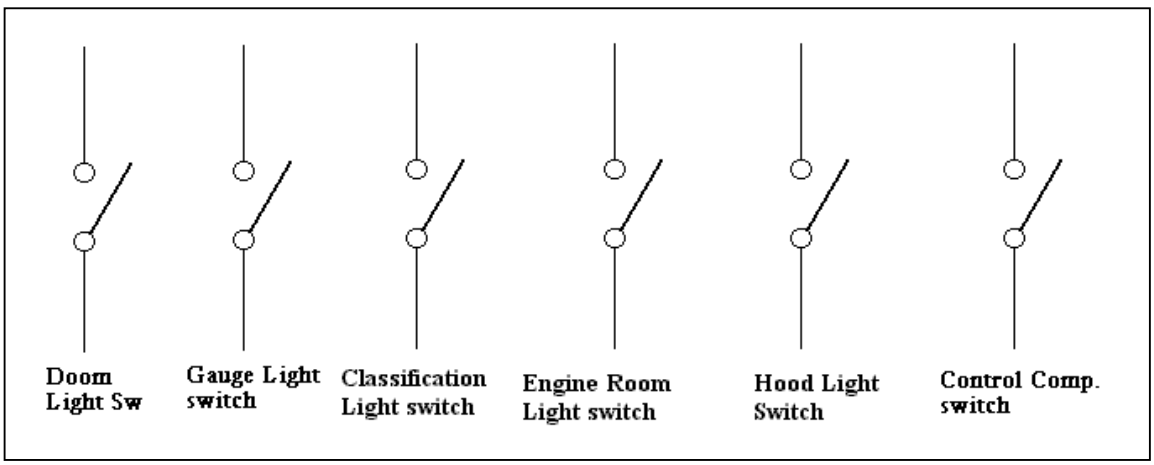
Location : It is in front panel. Normally it must be in closed and in sealed condition.

Purpose : Through this GR coil terminal is connecting to source of power.
By breaking seal and opening GRCO switch on emergency GR can be isolated.

ii. Toggle switch : It is a manually operated switch.

Location : On Front Panel and on control stands.

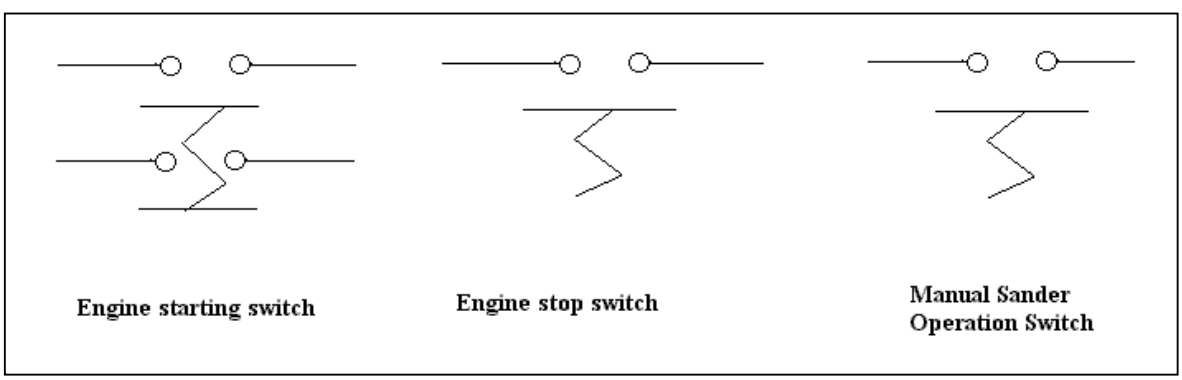
Purpose : It is mostly used to control the lights like doom light, cab lights, engine room lights, hood lights, classification lights and EPG Gov. etc



iii. Push Button switches : (Manually operated switch).

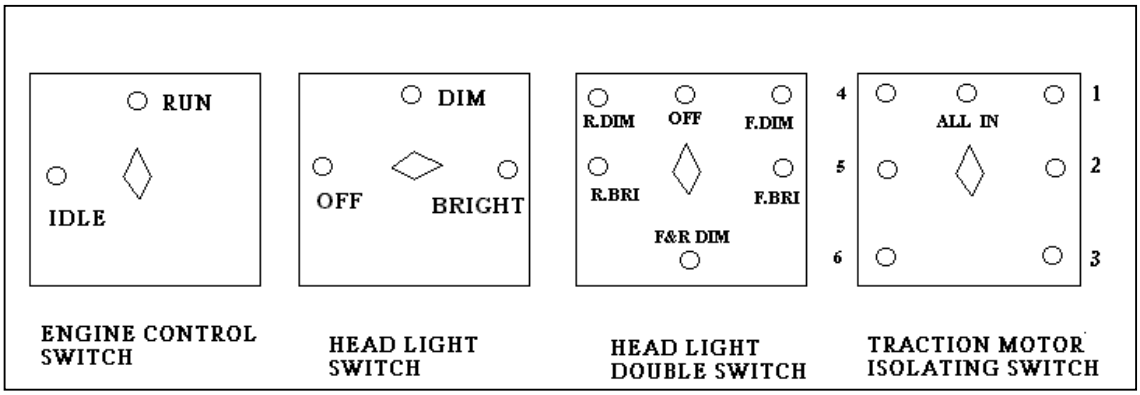
Location : On Front Panel.(Engine starting switch, Engine stop switch) and on control stands manual sanders operation switch.

Purpose : These are used to start the Diesel engine, to shut down the diesel engine and also for manual sanders operation



iv . Rotatory switch : (Manually operated switch). To control different circuits in different positions.

a. Engine control switch(ECS):
Location: On Front Panel.



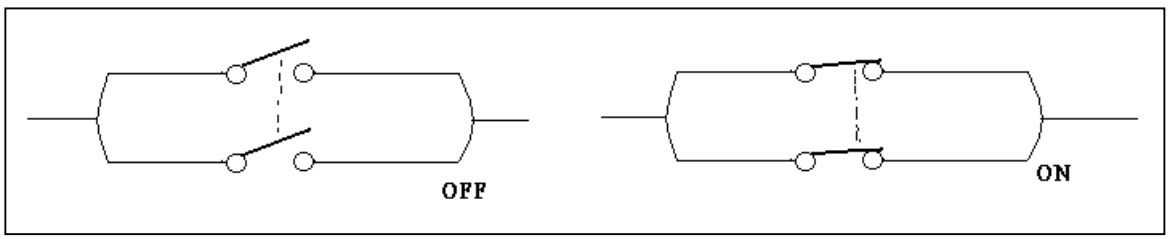
Purpose: It is used to start the diesel engine, to raise the diesel engine speed, to move the locomotive, to get dynamic brake operation. On Run during emergency, it will bring engine to idle and load meter to zero.
It will have two positions 1. Idle 2.Run.

b. Head light Switch: It is used to control the headlights for dim, bright, off totally two switches are located on control stands. (One on each control stand)

c. Motor Isolation Switch (Motor cut out switch): Out of 6 traction motors as if any one motor goes defective by this switch we can isolate and work further.
It is available in few locomotives, this switch is located on Front Panel.

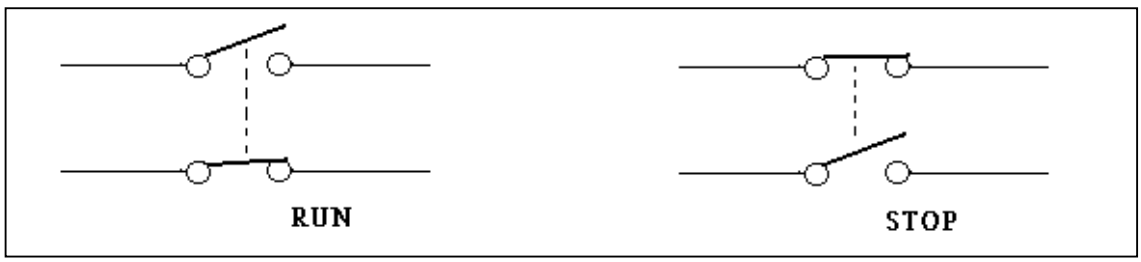
v. Generator field cut out switch(GFCO) : (Manually operated switch).
Double pole with 'on' and 'off' switch. Both GFCOs on control stands are connected in series.

Location : Sides of both control stands in between MFPB & MCB breakers.



Purpose : It is used to close the generator field contactor. Because both are double pole switches if any one goes defective other switch will make circuit to close. This switch is going to be operated number of times by the driver during each trip.

vi. Multiple unit shut down switch (MUSD) : Manually operated with double pole switch. Out of two poles in one position one switch will be in closed and other will be in open condition, in the second position closed switch will be open and open switch will be closed condition. There by we should not call 'on'/'off' switch. In MUSD switch two positions are 'RUN'/'STOP'



AUTOMATICALLY OPERATED SWITCHES

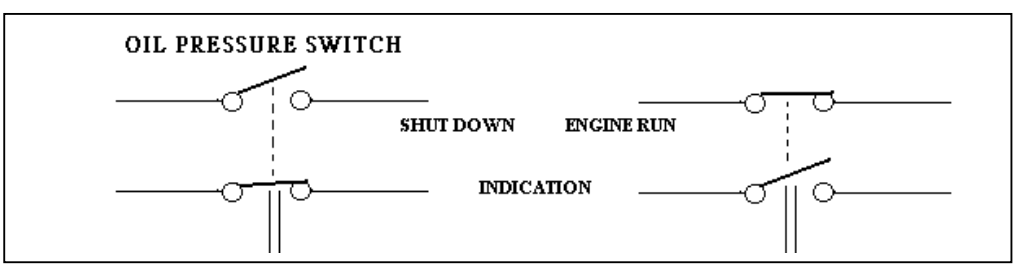
i. Pressure switch: These are the switches operating by air pressure or oil pressure.

Location: Near AFL unit pneumatic control switch (PCS) , in drivers cab oil pressure switch (OPS) are provided.

a. Pnematic control switch (PCS):

Refer AFL unit .

b. Oil pressure switch (OPS): Provided in GE governor locomotives only. These are two switches 1) OPS-1 2) OPS-2

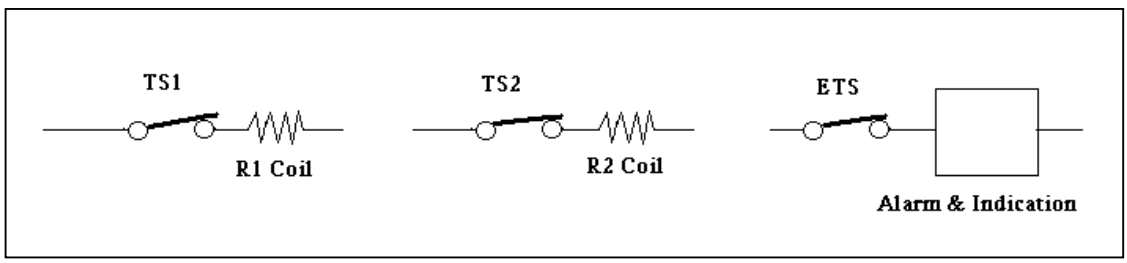


(i) Oil pressure switch (OPS-1): It is located in Driver's cab and connected in Engine lube oil system. After cranking if Lube oil pressure is 1.6 kg/cm^2 , it is going to pick up and makes engine to hold (Run). Whenever lube oil pressure drops below 1.3 kg/cm^2 it makes engine to shut down. It will act up to 6th notch only.

(ii) **Oil pressure switch (OPS-**2): On 7th & 8th notches if Lube oil pressure is above 3.7 kg/cm^2 it will pick up and it drops below 3.5kg/cm^2 · and makes engine to shut down

c. Thermal switch: It is going to operate on water temperature.

Location: There are three switches located in Expressor room and these are connected in Engine cooling water system.



Purpose:

i. **Temperature switch (TS1):** Whenever temperature of cooling water raises to 68°C this switch will be closed, R1 contactor will close and Radiator fan starts working full speed.

ii. **Temperature switch (TS2):** Whenever engine cooling water temperature raises to 74°C this is going to operate, R2 contactor will close and Radiator fan starts working at full speed.

iii. **Engine temperature switches (ETS):** Whenever engine cooling water temperature raises to 90 ° C this is going to operate and makes hot engine indication with alarm.

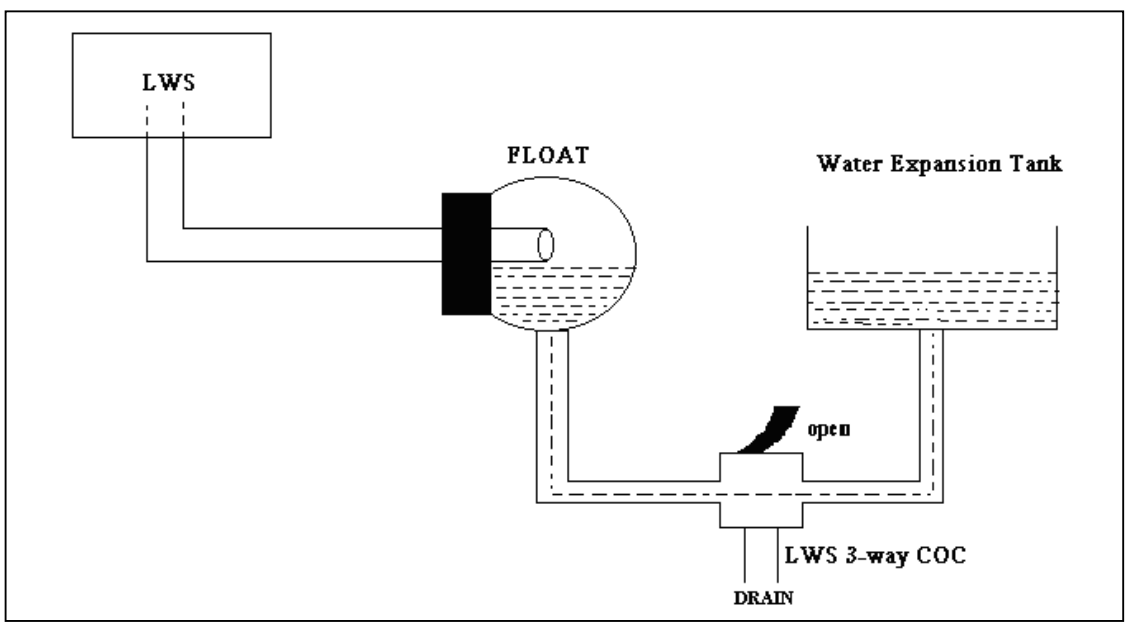
Note: No change in engine speed and locomotive speed.

d. **Floating switch:** It is going to operate by the water level in water expansion tank.

Location: It is in cooling water system on the top of Expresser room.

Low water switch (LWS): It is connected with LWS 3-way cut out cock to expansion tank. If water level is sufficient,(In expansion tank from the bottom above 1") this switch will be in normal and allows to run the engine. Whenever water level in expansion tank reduces below 1" from the bottom of the expansion tank, this switch is going to operate and makes engine to shutdown with hot engine indication with alarm.

During engine starting with low water, Engine will crank but firing will not takes place.



For both LWS and ETS operations indication will be Hot engine with alarm. To identify if engine shuts down with HEA, LWS may be operated, if engine is in running with HEA, ETS may be operated.

BREAKERS

Circuit Breakers: It is a device used to make and break the circuits with protection. It is going to work as a protecting device for electrical circuits. If the circuits are exceeding its rated current, then breaker will trip and protect the equipments, wiring and switches. Normally these will have three positions On, Off & Trip. Once breaker tripped to reset first keep in "Off" and then switch on.

Sl No	Name Of the Breaker	Location	Energizing/ Protecting in shut down	Energizing / protecting in engine running	Effect on Tripping in shut down	Effect on tripping in engine running
1	Battery Breaker (MB1)	On control panel	All control circuits (Battery +ve only)	Only battery circuit (charging/ discharging)	Engine not cranking (control circuits will not energize)	Battery ammeter shows '0'(zero)
2	Control Breaker (MB2)	On control panel	All control circuits (Battery & Auxiliary -ve)	All control circuits (Negative energizing)	Engine not cranking (control circuits will not energize)	Automatic engine shutdown
3	Master Fuel Pump Breakers (MFPB1 & MFPB2)	On control stand 1 & 2	Fuel pump contactor & other control circuits	Fuel pump contactor & other control circuits	Engine not cranking, FPC will not close & control circuits will not energize	Automatic engine shutdown
4	Fuel pump Breaker (FPM)	On control panel	FP motor and engine starting circuits, Engine Governor & radiator fan circuits	FP motor and engine starting circuits, Engine Governor & radiator fan circuits	Engine not cranking starting circuits will not energize	Automatic engine shutdown (GOV circuits De energizing and FP motor Off
5	Crank Case Exhauster motor Breaker (CCEM)	On control panel	Crank case exhauster motor working	Crankcase exhauster motor working	CCEM motor breaker failure indication	Spring loaded explosive doors opening after some time. No change on engine running.
6	Auxiliary Generator Field Breaker (AGFB)	On control panel	No effect in shut down condition	Auxiliary generator armature supply is connected to Aux Gen Field through VRP	No effect on engine during starting/working.	Battery ammeter will show discharge.

Sl No	Name Of the Breaker	Location	Energizing/Protecting in shut down	Energizing /protecting in engine running	Effect on Tripping in shut down	Effect on tripping in engine running
7	Master control breaker 1 & 2 (MCB1 & MCB 2)	On control stand 1 & 2	Engine speed circuit (DMR, ESR1, 2, 3, 4,) (ERR, AV, BV, CV & DV Solenoids)	Engine speed circuit (DMR, ESR1, 2, 3, 4) (ERR AV, BV, CV & DV Solenoids)	No effect on engine during starting.	Throttle will not respond.
8	Head light breaker (HLB)	On control panel	Head lights will glow through switches	Head lights will glow through switches	Both head lights will not glow	Both head lights will come to off
9	Lighting Breaker	On control panel	All locomotive lights will work through switches	All locomotive lights will work through switches	Lights will not glow	Lights will come to off
10	Dome light breaker	On control panel	Only Dome light will glow through switches	Only Dome light will glow through switches	Dome Light will not glow	Dome light will come to off
11	Dust Exhauster motor breaker	On control panel	Dust exhauster motor (two) will starts working	Dust exhauster motor (two) will starts working	Dust exhauster motors will not work	Dust exhauster motors will come to off
12	Duplicate Breakers a)MFPB' - SHCS b)'MCB' - LHCS c) 'FPB' - On panel d)'AGFB'- do - e) 'CCEB' - do - f) 'ERFB' - do -	Short hood control stand, Long hood control stand & On control panel	If any defective in original breaker these duplicate breaker will make to energize the circuit	If any defective in original breaker these duplicate breaker will make to energize the circuit	If duplicate breaker also going to trip particular circuit may be defective	If duplicate breaker also going to trip particular circuit may be defective

RELAYS

These are electromagnetic and remotely controlled switch devices, which are making and breaking control circuits. In this, normally open and normally closed inter-locks are there. If relay is operated normally open (N/O) will close and normally closed (N/C) will open.

The following are the relays used in the locomotives.

1. Signal Relay:

Location: In Front Panel.

Purpose: During safety devices (like OPS, LWS, ETS GR & GFOLR) operation this relay is going to energize and make the alarm gong (bell) to operate.

If it fails: Alarm gong (bell) will not operate during safety devices operation.

2. Dead Mans Relay (DMR):

Location: In Front Panel.

Purpose: It is controlled and protected by MCB 1 & 2 breakers. During A9 emergency or fireman emergency application, in brake system either vacuum failure or BP failure HB5 or PCS 2 will operate, this makes the PCS to knock out (open) and DMR relay to de-energize (drop) due to this engine RPM will return to idle.

If it fails: Throttle will not respond.

3. Engine Speed relay (ESR_1, ESR2, ESR3, ESR4):

Location: On Front Panel. These are available in G.E.Governor Locomotives only. There are four ESR relays in locomotive.

Purpose: According to throttle handle position, these relays are going to Energize and de-energize for engine speed changing.

1.	Idle	-	No ESR will energize.
2.	1st Notch	-	No ESR will energize
3.	2nd Notch	-	ESR_1
4.	3rd Notch	-	ESR_3
5.	4th Notch	-	ESR_1 & ESR_3
6.	5th Notch	-	ESR_2, ESR_3 & ESR_4
7.	6th Notch	-	ESR_1, ESR_2, ESR_3 & ESR_4
8.	7th Notch	-	ESR_2 & ESR_3
9.	8th Notch	-	ESR_1, ESR_2 & ESR_3

If it fails: If any relay is not picking up erratic RPM will be experienced

4. Field Shunt Relay (FSR):

Location: Front Panel of WDM2 and WDP1 only.

Purpose: During first and third transitions (in WDM 2)and only one transition (in WDP1) this relay will energize and makes FS contactors to close, there by traction motor field shunting (Field current diversion) will takes place.

If it fails: Field shunting will not takes place. Minimum acceleration will effect on train.

5. Transition Relay (TR):

Location: Front Panel.

Purpose: During second transition, this relay is going to energize, makes dropping of Series – Parallel with FS contactors, and picks up all parallel power contactors.

If it fails: Second transition will not pick up.

6. Safety Auxiliary Relay (SAR):

Location: Front Panel.

This is fitted only in G.E.Governor locomotives. It is getting Tacho Generator supply whenever engine speed reaches to 220-RPM SAR will pick up.

Purpose: Due to any reason on run, if TACHO generator supply fails to G.E.Governor speed coil circuit, immediately SAR will de-energize and makes engine to shut down without indication.

If it fails:

1. During engine starting if relay is not energizing engine over speeding and OSTA tripping engine shutting down will takes place.
2. After picking up of SAR if interlock is defective engine will crank and fire but holding will not takes place.

7. Ground Relay (GR):

Location: Front Panel.

Purpose: Whenever earth fault/leakages takes place in power circuit, immediately this relay will energize.

After energizing the following changes will take place: -

a) Engine speed will come to idle.
b) Load meter will come to zero (GF contactor open).
c) Audiovisual indication (Alarm gong & GR indication).
d) Re-setting button projects.
e) Pointer will be on red dot.

During engine starting, if any earth fault/leakages in control circuits, GR will energize and Gives only indication with bell to the operator. There is no effect on engine starting system. After releasing start button GR can be resetted.

This relay can be isolated by opening the Ground relay (GR) cutout switch by getting official permission only.

Resetting procedure: Keep a) Throttle handle in idle
b) Reverser in neutral
c) Both GFCO switches off on control stands
d) ECS in idle and then press the GR resetting button.

8. Braking Relay (BKR):

Location: Front panel.

In single BKT & REV locomotives, BKR_1, BKR_2 & BKR_3 will be there. In double BKT & REV locomotives, only one BKR will be there.

Purpose: It is going to energize, whenever selector handle is in zero Position it changes the circuits from motoring to braking.

If it fails: In motoring and braking load meter problem will come (less or over shooting of load meter)

9. Wheel Slip Relay (WSR):

Location: Front Panel

There are three wheel slip relays. (WSR1, WSR2 & WSR3) In each relay, there are two coils.

a) Series-parallel coil.(It is going to energies only in series parallel + FSC combination)
b) Parallel coil.(It is going to energies parallel + FSC combination)

The arrangement of WSR 1, WSR 2 & WSR 3 in series parallel and parallel combination in between Traction Motors is as below: -

Combination	**WSR 1**	**WSR 2**	**WSR 3**
Series parallel	TM Nos 1 & 4	TM Nos 2 & 5	TM Nos 3 & 6
Parallel	TM Nos 1 & 5	TM Nos 2 &3	TM Nos 4 & 6

Purpose: If any traction motor is going to be un-balanced then this relay is going to energize (i.e. if there is any potential difference in between two traction motors)

a) Gradually Load meter will drops to zero.
b) Automatically sanders will operate.
c) Audio, Visual indication (Buzzer and Wheel slip indication).

The above relays are located in GE Governor Locomotives only. In Wood ward governor Locomotives ESR 1,2,3,4 & SAR (Five relays) are removed and added ERR, C 'Valve' relay and MUSDR.

In Woodward governor locomotives

1. **Engine Run Relay (ERR):**

   Location: In Front Panel.

   ERR will pick up after keeping ECS to run (if DMR in pick up condition).

   .

   Purpose: It will work as mediator between Governor and Engine. Due to some safety devices operation, it de-energizes, for bringing the engine to idle (GR&GFOLR) and engine to shutdown (LWS) through WW governor.

   If it fails: Throttle will not respond.

2. **'C' Valve Relay (CVR or ESR3):**

   Location: In Front Panel.

   Purpose: It will energize from third notch onwards (acts like ESR3 to give notch position to excitation system).

3. **MUSDR (Multiple Unit Shut Down Relay) :**

   Location: In Front Panel.

   Purpose: Whenever MUSD switch is operated to 'STOP' engine will shutdown due to DV solenoid and MUSD relay will pickup. During re-cranking with MUSD switch in Stop position MUSDR relay make not to crank the engine (CK1 and CK2 will not close) Indirectly batteries are protected from discharging due to repeated cranking.

CONTACTORS

Contactor: It is an electromagnetic device used in various types of (High current rating) electrical circuits to make and break the circuits. In this, there are two types of contactors.

1. Electromagnetic contactors.
2. Electromagnetic & pneumatic contactors.

ELECTROMAGNETIC CONTACTORS: When coil of these contactors are energized, the core gets magnetized and movable tip moves on fixed tip. When the current is with drawn to the coil, the core is de-magnetized and movable contact opens from fixed contact due to spring action.

1. Fuel pump contactor (FPC) : It is located in Front Panel. Whenever $MFPB_1$ & $MFPB_2$ switched 'ON' FPC will close.

Purpose: To energize many control circuits especially engine starting and running circuits.

If Fails : During starting if it is not closed engine will not crank. During running, if it fails engine will come to shut down.
On emergency FPC can be packed and work onwards.

2. Cranking contactors : (CK_1 & CK_2) : It is located in Front Panel. Whenever start button is pressed these contactors will close.

Purpose : If CK_1 closes positive (+ve) supply goes to main generator and if CK2 closes negative (-ve) supply goes to main generator. It is having interlocks for controlling some other control circuits.

If Fails : If contactors defective engine will not crank & interlocks defective, mainly GF contactor will not close.

3. Generator Field Contactors (GFC) : It is located in Front Panel. Whenever both GFCO switched 'ON' from both control stands GF contactor will close.

Purpose : To connect exciter generator supply to main generator field for field excitation.

If Fails : Load meter will drop to zero (or) Load meter will not respond.
On emergency GFC can be packed and work onwards

4. Radiator fan Contactors : (R1 & R2) : These are located on Back Panel. Whenever engine cooling water temperature raises (68 & 74 degrees), TS.1 & TS.2 will close. If TS.1 closes R1 contactor and if TS.2 closes R2 contactor will be closed.

Purpose : To give auxiliary generator supply to eddy current clutch for rotating radiator fan.

If Fails : If there is no supply to ECC, Radiator fan will not work. Engine water temperature will raise to 90°C and engine temperature switch (ETS) will pick up. Hot engine indication and alarm will come, no change in the engine speed. Then put ON ERF breaker.

5. Field Shunting Contactors (F.S.C) : These are located in back Panel. During 1st and 3rd transition field shunting relay will energize and makes six (6) F.S. contactors (FS 21 to 26) to close.

Purpose : To divert traction motor field current (or) weakening traction motor field current and to get acceleration in Traction Motor.

If Fails :

a) During first transition if any FS contactor is not closing (picking up) and another five contactors closes continuously wheel slip relay will operate.
To work further, Apply manual II nd transition all FS contactors will drop. Again, at III rd transition, same problem will arise. To work further remove
210 – 3 card III rd transition will not pickup.

b) While starting the Loco if any FS contactor is welded continuously wheel slip relay will operate.
To work further; Start the Loco with direct I st transition remaining five FS contactors will also close. Again at II nd transition, same problem will arise. To work further apply manual III rd transition remaining five contactors will also close.

ELECTROMAGNETIC & PNEUMATIC CONTACTORS:
(The required control air pressure is 5 kg/cm^2).

When operating coil of these contactors are energized, it opens the passage for control air. This control air pressure forces movable tip on to fixed tip. When the coil is de-energized exhaust port opens and movable tip comes to original position with the help of spring.

1. Series Parallel Contactors : (S_1,S_{21},S_{31}) :

These are located in Front Panel. During locomotive movement these contactors will close.

Purpose: To make the six traction motors in series parallel combination (1 & 4 TMs in S1, 2 & 5 TMs in S31 & 3 and 6 TMs in S21).

If Fails: Load meter will not indicate (if S1 not picking up) and hauling power is effected, (if S21 or S31 not picking up) only Hauling power is effected.

2. Parallel Contactors: (P_1, P21, P31, P2, P22, P32): These are located in Front Panel. During second transition, transition relay will pickup and makes to energize all parallel power contactors.

Purpose: To make all six traction motors in parallel to main generator (parallel combination).

If Fails:

1. During second transition load meter will not respond if P32 not picking up.
2. Hauling power is effected if any one power contactor is not picking up.
3. Load meter will not indicate if P2 not picking up.

3. Braking Switches (BKT_1, BKT_2): These are located in Front Panel. Operation like power contactors.

Purpose: The power break switch changes the connections of the armature and fields of the traction motor suitably for motoring and dynamic braking. It is also off load operated power switch. It will decide locomotive to work for motoring or braking. It is under the control of selector handle.

BKT 1 Controls traction motor Nos 1, 4, 3 & 6

BKT2 controls traction motor Nos 2 & 5

and in **single BKT** locos it will control all six traction motors.

If Fails: During motoring load meter will not respond and during braking dynamic brake will not work.

4. Reverser Switch (REV_1, REV2): It is located in Front Panel. Operation same as BKT's.

Purpose: The Reverser is remotely controlled off load operated power switch used for reversing the direction of rotation of traction motor. It is under the control of reverser handle.

REV 1 controls traction motor Nos 1, 4, 3, 6 and **REV 2** controls traction motors 2 & 5 and in single reverser locos it will control all six traction motors.

If Fails: In one direction load meter will not respond.

In double BKT locomotives in dynamic brake except P_2, P_{22} remaining power contactors S_1, S_{21}, S_{31}, P_1, P_{21}, P_{31}, P_{32} will pick up and also only one BKR relay is going to operate.

In single **BKT** locomotives during dynamic brake except P_2, P_{22}, S_{21} & S_{31} remaining power contactors S_1, P_1, P_{21}, P_{31}, P_{32} will energize and also BKR_1, BKR_2 & BKR_3 will operate.

CONTROL PANELS

1. Engine Control Panel: (ECP): It is located in Front Panel. It is getting supply from Tacho Generator. 3 phase A.C. supply.

Purpose: GE. Governor:

1. To give engine speed signal to governor.
2. To give engine speed signal to excitation system.

In WW. Governor:

1. To give engine speed signal to excitation system.

If It Fails: In G.E. Governor :

Engine speed is going to affect and load meter also drops to zero.

In W.W. Governor : Only Load meter will drop and there is no effect on engine speed.

2. Excitation Panel : It is located in Front Panel below the E.C.P. It will have female sockets and male pins. Seven plug in type cards are provided for quick changing. card nos are 253, 186, 187, 188, 254, 292, 293.

Purpose : It controls directly exciter generator field & indirectly main generator output is going to be controlled.

If it Fails : Mainly the main generator function will be unsatisfactory. (load meter zero, load meter shooting or hauling power poor)

3. Transition Front Panel : (TRP) : It is located in Front Panel. It is getting locomotive speed signal from axle driven alternator through transition excitation transformer(TET). It will have 4 cards

1. 207 - control card	-	To give electrical signal to 210 – 1,2 & 3 cards
2. 210-1 control card	-	for 1st transition to pick up and drop field shunting relay
3. 210-2 control card	-	for 2nd transition to drop series parallel and field shunting combination and to pick up parallel combination through transition relay
4. 210-3 control card	-	for 3rd transition to pick up/drop field shunting relay.

If It Fails : Auto transition problem will come work with manual by removing all the four cards.

4. Voltage Regulating Panel : (VRP) : It is located in Front Panel. It will have two cards.

BX.Card - Power Card.
BN Card - Control Card.

And also it is having one fuse to protect VRP and regulating knob to adjust Auxiliary Generator voltage to 72 $\pm$ 1 volts.

Purpose : It controls the auxiliary generator field to get auxiliary generator voltage constant. (72 $\pm$ 1) irrespective of notch position (engine speed).

If it Fails : If it maintains less than Battery voltage Battery ammeter will show discharge, if it maintains more than 72 ± 1Volts Battery ammeter will read overcharge.

GOVERNOR

An Engine Governor is commonly a speed sensitive device that automatically controls the speed of the Engine by adjusting the amount of fuel fed to the engine.

Location: Engine Right side Power takes off end.

Functions:

1. It maintains constant engine speed irrespective of Load and Road.
2. If makes to shut down the diesel engine incase of low lube-oil pressure and low water level.
3. It helps in starting the diesel engine.
4. It helps to increase and decrease the engine by varying fuel rack.

Important coils in Governor (G.E. Governor)

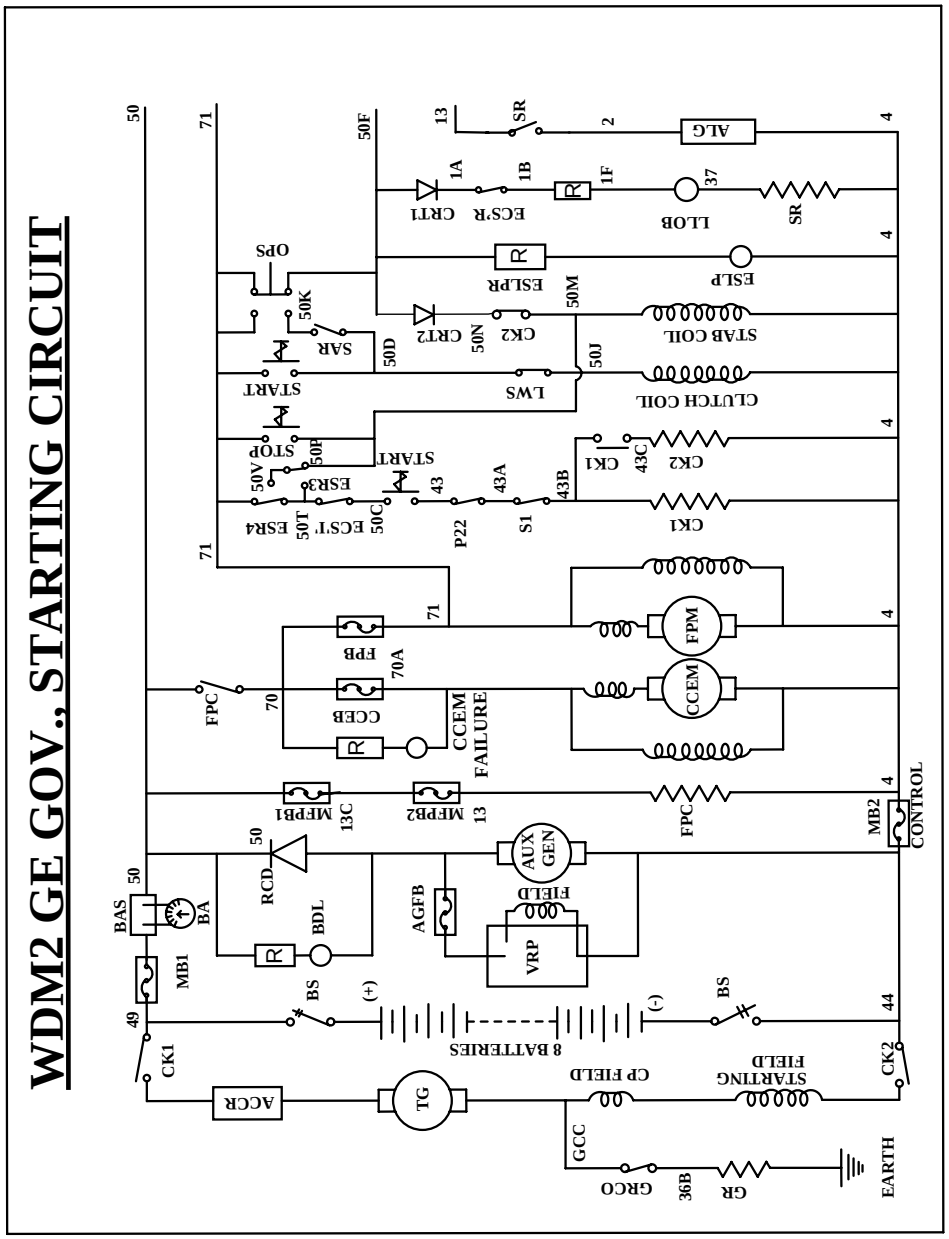
1. Stabilizing coil:
   a) If it is energized before starting the engine it brings "A" arm nearer to "B" arm
   b) On Run if it is energized engine comes to shutdown by bringing A & B arms to No Fuel position.

2. Clutch coil:
   a) If clutch coil gets supply "A" and "B" arms are magnetically locked (A arm and B arm must be nearer)
   b) On Run if it is de-energized engine comes to shutdown (incase of OPS, SAR,LWS etc., operation) by making A& B arms separation.

3. Speed coil:

According to Throttle Handle position speed coil current is changing due to this amount of fuel changing causing for engine RPM changing.

ENGINE STARTING SYSTEM
(GE GOVERNOR.)



Engine starting system can be divided into three parts.

1. Engine cranking,
2. Engine Firing and
3. Engine holding.

1.<u>Engine Cranking</u>: Means CK1 & CK2 contactors closing and battery supply is feeding to main generator to work as a motor to crank the Diesel engine.

a. Battery knife switch to be switched on.

b. MB1 (Battery) breaker to be switched on.

Result: Battery discharging lamp (Auxiliary Generator failure) indication will glow.

c. MB2 (Control) breaker to be switched on.

Result : Switch on all the lighting breakers and switches (except doom light and flasher light) , lamps will glow.

d. .MFPB1 & MFPB2 to be switched "on" on both control stands.

Result: FPC contactor coil will be energized and with click sound contactor will close.

e. If FPC contactor closed properly,

Result: CCE motor failure indication will glow.

f. CCEM breaker to be switched on.

Result: CCE motor failure indication will goes off and CCEM starts working.

g. FPB breaker to be switched on.

Result:

i) Fuel pump motor will start and fuel oil pressure will build up to 3.8 kg/cm2.

ii) Engine starting lamp will glow.
In governor, stabilizing coil will energize with click sound.

h. ECS to be kept in run position for 3 times.

Result: With low lube oil indication SR will energize and bell will ring.

i. MUSD in both control stands must be in run condition.

j. ECS must be in idle condition.

k. Start button to be pressed (This will have two switches).

Result: (Switch no.1) : Through ESR-4 N/C interlock, through ECS RUN closed interlock, through start button, through P-22 power contactor N/C interlock, through S1 power contactor N/C interlock , CK1 contactor will pick up. Through CK1 closed bridge interlock, CK2 contactor will energize

When CK1 and CK2 contactors are closed, Generator will work as a motor and engine is going to crank.

2. **Firing** : Means stabilizing coil energizing, clutch coil energizing and stabilizing coil de-energizing.

   a. Already stabilizing coil energized when FPB switched ON.

   b. (Start Switch No.2) : Clutch coil will energize through LWS (if sufficient water is available).

   c. When CK2 contactor picks up CK2 bridge interlock will open and makes stabilizing coil to de-energize.

   Result: Fuel racks will move towards Fuel increasing and engine will get firing.

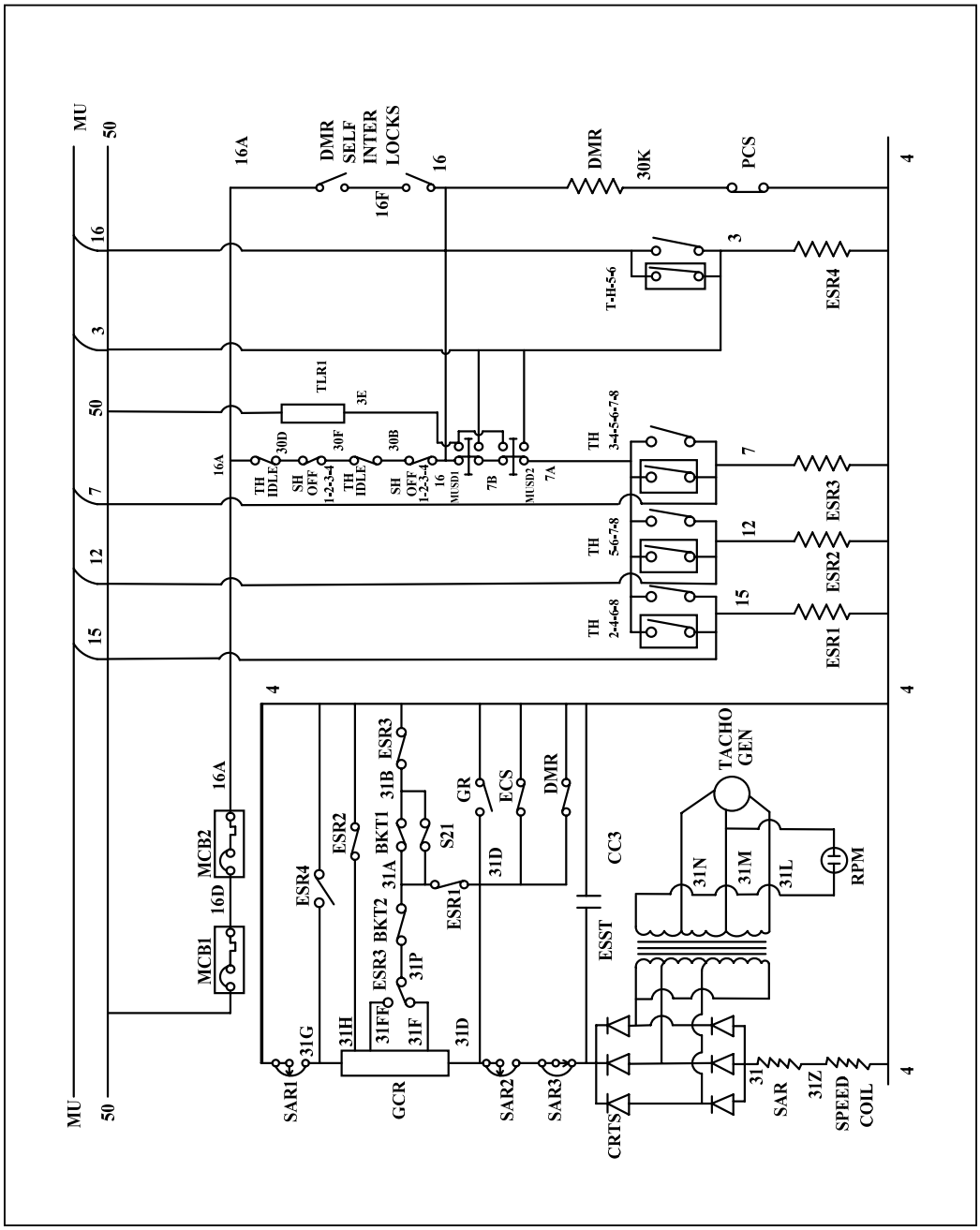
3. **Holding**: If engine starting lamp goes off, leave start button. Engine will run on its own then it is called Holding.

   a) SAR will pick up whenever engine speed reaches more than 220 RPM.

   b) OPS will pickup whenever lube oil pressure builds up 1.6 kg/cm2

   Result: Clutch coil will get permanent supply and engine will hold.

ENGINE SPEED CIRCUIT
(GE GOVERNOR)



If engine speed is responding according to the throttle handle position, we can say that throttle is responding.

It can be divided into three parts.

1. DMR energizing.
2. ESRs energizing.
3. Governor speed coil circuit.

1. DMR ENERGISING :
   a. MCB1 & MCB2 to be switched on (closed) on both the control stands.
   b. Throttle handle in idle and selector handle "0" , 1, 2, 3, 4 position in working control stand.
   c. Throttle handle in idle and selector handle '0', 1, 2, 3, 4 position in non working control stand.
   d. PCS must be in normal position (closed).

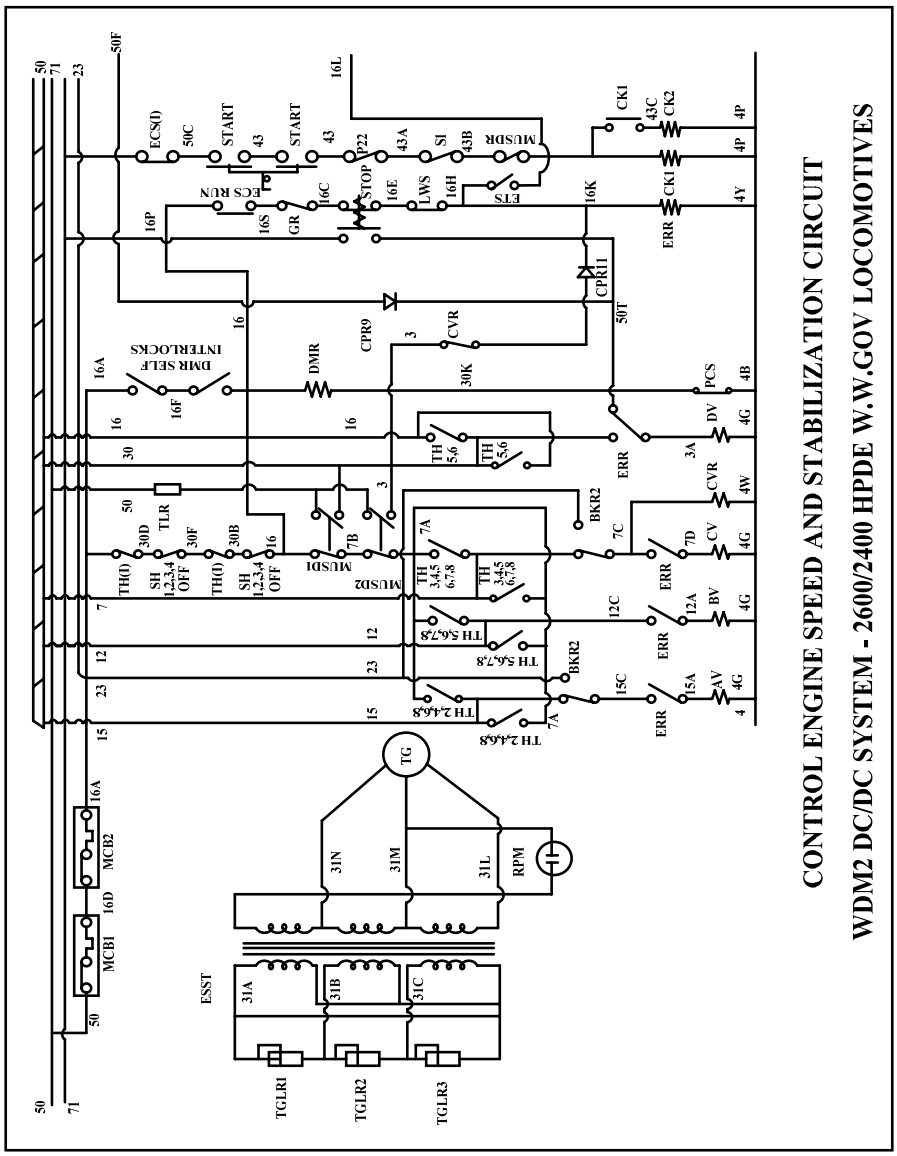
Result: DMR will pick up (energise).
Throttle handle in idle, DMR is energizing and throttle handle in first notch, if DMR is dropping (de-energising) "DMR SELF INTER LOCKS '" are defective.

2. ESRs ENERGISING :
   a. Through MUSD1 closed switch and MUSD2 closed switch in both control stands for throttle handle supply readily available.
   b. Through throttle handle inter locks ESR relays will energise.
   c. ESR 4 will get power directly from DMR self interlocks(it is not under control of MUSD 1&2)

ESR RELAYS	NOTCH POSITION
ESR 1	2, 4, 6, 8
ESR2	5, 6, 7, 8
ESR3	3, 4, 5, 6, 7, 8
ESR4	5, 6

Throttle handle 1, 2, 3, 4 notches engine speed is not raising and in 5th notch engine is shutting down "MUSD1 or MUSD2" switches may be defective or wire cut.

ENGINE STARTING SYSTEM
(W. W. GOVERNOR)



Engine starting system can be divided into three parts.

1. Engine cranking.
2. Engine Firing and
3. Engine holding.

1. Engine Cranking : It means CK1 & CK2 contactors closing and battery supply is feeding to main generator to work as a motor to crank the Diesel engine.
   a. Battery knife switch to be switched on.
   b. MB1 (Battery) breaker to be switch held on.

   Result : Battery discharging lamp (Auxiliary Generator failure) indication will glow
   c. MB2 (control) breaker to be switched on.

   Result: switch on all the lighting breakers and switches, (except doom light and flasher light) lamps will glow.
   d. MFPB1 & MFPB2 to be switched "on" on both control stands.

   Result : FPC contactor coil will be energized and with click sound contactor will close
   e. If FPC contactor closed properly,

   Result: CCE motor failure indication will glow.
   f. CCEM breaker to be switched on.

   Result: CCE motor failure indication will goes off.. and CCEM starts working.
   g. FPB breaker to be switched on.

   Result: Fuel pump motor will start and fuel oil pressure will build up to 3.8 kg/cm2.
   h. MUSD in both control stands must be in run condition.
   i. ECS must be in idle, condition
   j. Start button to be pressed.

   Result: Through ECS idle closed interlock, through engine start button closed switches, through P 22 power contactor N/C interlock, through S1 power contactor N/C interlock , through MUSDR relay N/C switch (Run) CK1 contactor will pick up. Through Ck1 closed bridge interlock, CK2 contactor will pickup.

   When CK1 & CK2 contactors are closed, generator will work as motor and engine is going to crank.

   k. **Firing and holding will be done by Woodward governor**.

ENGINE SPEED CIRCUIT
W.W. GOVERNOR

If engine speed is responding according to the throttle handle position, we can say that throttle is responding.

It can be divided into two parts.

1.DMR energizing,

2.Solenoids energizing,

1.DMR ENERGISING :

a. MCB1 & MCB2 to be switched on (closed) on both the control stands.
b. Throttle handle in idle and selector handle "0", 1,2,3,4 positions in working control stand.
c. Throttle handle in idle and selector handle "0", 1,2,3,4, position in non-working control stand.
d. PCS must be in normal position (Closed)

Result : DMR will pickup (energize)

Throttle handle in idle, DMR is energizing and throttle handle in first notch, if DMR is dropping (de-energising) "DMR SELF INTER LOCKS' are defective.

e. ERR will pickup (energise)

Through ECS "R" closed interlock, GR N/C interlock, stop button closed switch and LWS closed switch ERR will pickup

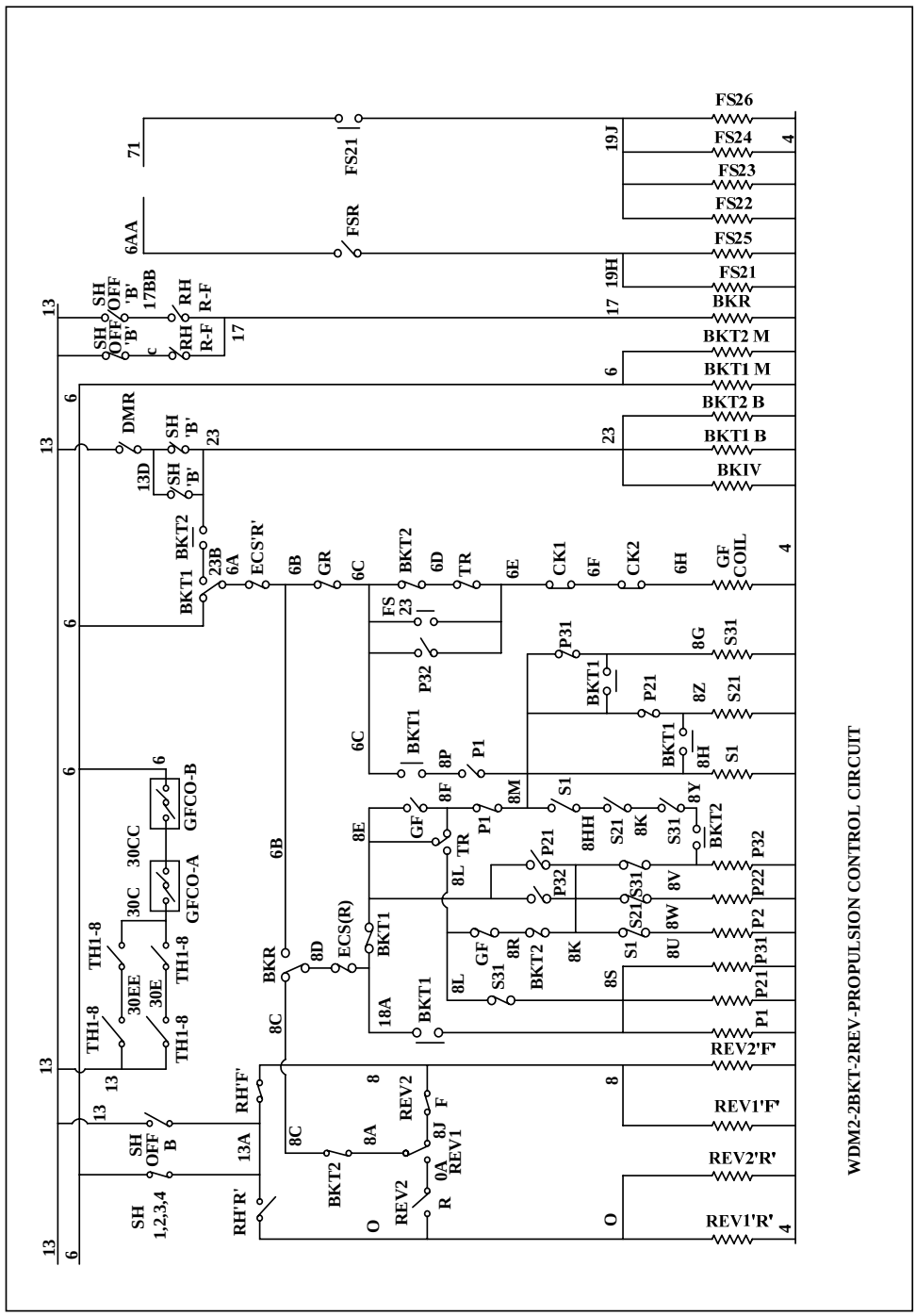
2. SOLENOIDS ENERGISING :

a. Through MUSD1 closed switch and MUSD2 closed switch in both control stands for throttle handle supply readily available.
b. Through throttle handle interlock through BKR2 relay N/C interlock and ERR relay closed interlock AV solenoid will energise.
c. Through throttle handle inter lock and ERR relay closed interlock BV solenoid will energize.
d. Through throttle handle inter lock through BKR2 relay N/C interlock and ERR relay closed interlock CV solenoid will energise.
e. Through throttle handle interlock and ERR relay closed interlock DV solenoid will energise.

SOLENOIDS	NOTCH POSITION
AV Solenoid	2, 4, 6, 8
BV Solenoid	5, 6, 7, 8
CV Solenoid	3, 4, 5, 6, 7, 8
DV Solenoid	5, 6

Throttle handle 1, 2, 3, 4 notches engine speed is not raising and in 5th notch engine is shutting down "MUSD1 or MUSD2" switches may be defective or wire cut.

PROPULSION CONTROL CIRCUIT



GF CONTACTOR CLOSING

1. Through TH closed interlock 1- 8 notch (13 – 30EE – 30C).
2. Through Both GF switches ON (30C – 30CC – 6)
   Result: BKT 1 & 2 will throw towards motoring direction.
3. ThroughBKT1 (M) closed interlock (6 – 6A)
4. Through ECS (R) closed interlock (6A –6B)
5. Through GR N/C interlock (6B – 6D)
6. Through BKT2 (M) closed inter lock (6C – 6D)
7. Through TR N/C interlock (6D – 6E)
8. Through CK1 N/C Bridge interlock (6E –6F)
9. Through CK2 N/C Bridge interlock (6F – 6H)
10. GFC coil will energize (6H – 4)

S1 S21 & S31 POWER CONTACTOR CLOSING

1. Through SH closed interlock 1 – 4 positions (13 – 13A)
2. Through RH in forward closed interlock (13A – 8).
   Through: If RH in REV (13A – 0).
   Result: REV1 & REV2 will throw towards forward/Reverse direction.
3. Through REV 2 (F) closed interlock (8 – 8J)
   (a) REV 1 (F) closed interlock (8J – 8A)
   (b) REV 2 (R) closed interlock (0 – 0A)
   (c) REV 1 (R) closed interlock (0A –8A)
4. Through BKT 1 (M) closed interlock (8A – 8C)
5. Through BKR N/C interlock (8C – 8D)
6. Through ECS (R) closed interlock (8D – 18A)
7. Through BKT1 (M) closed interlock (18A – 8E)
8. Through GF closed interlock/TR N/C interlock (8E – 8F)
9. Through P1 N/C interlock (8E –8F)
   Result: S1 power contactor will pick up (8M – 4)
10. Through P21 N/C interlock (8M – 8Z)
    Result: S21 power contactor will pick up (8Z – 4)
11. Through P31 N/C interlock (8M – 8F)
    Result: S31 power contactor will pick up (8F – 4)

DURING 1ST TRANSITION (30 KM)

Axle driven alternator signal to (TET – 207 – 210/1)

Result: FSR relay will energize (6x - 4)

1. Through FSR closed interlock (6AA – 19H)
   Result: FS21 & FS25 contactors will pick up (19H - 4)
2. Through FS 21 closed bridge interlock (71 – 19J)
   Result: FS22, FS23, FS24 & FS26 contactors will pick up (19J – 4)

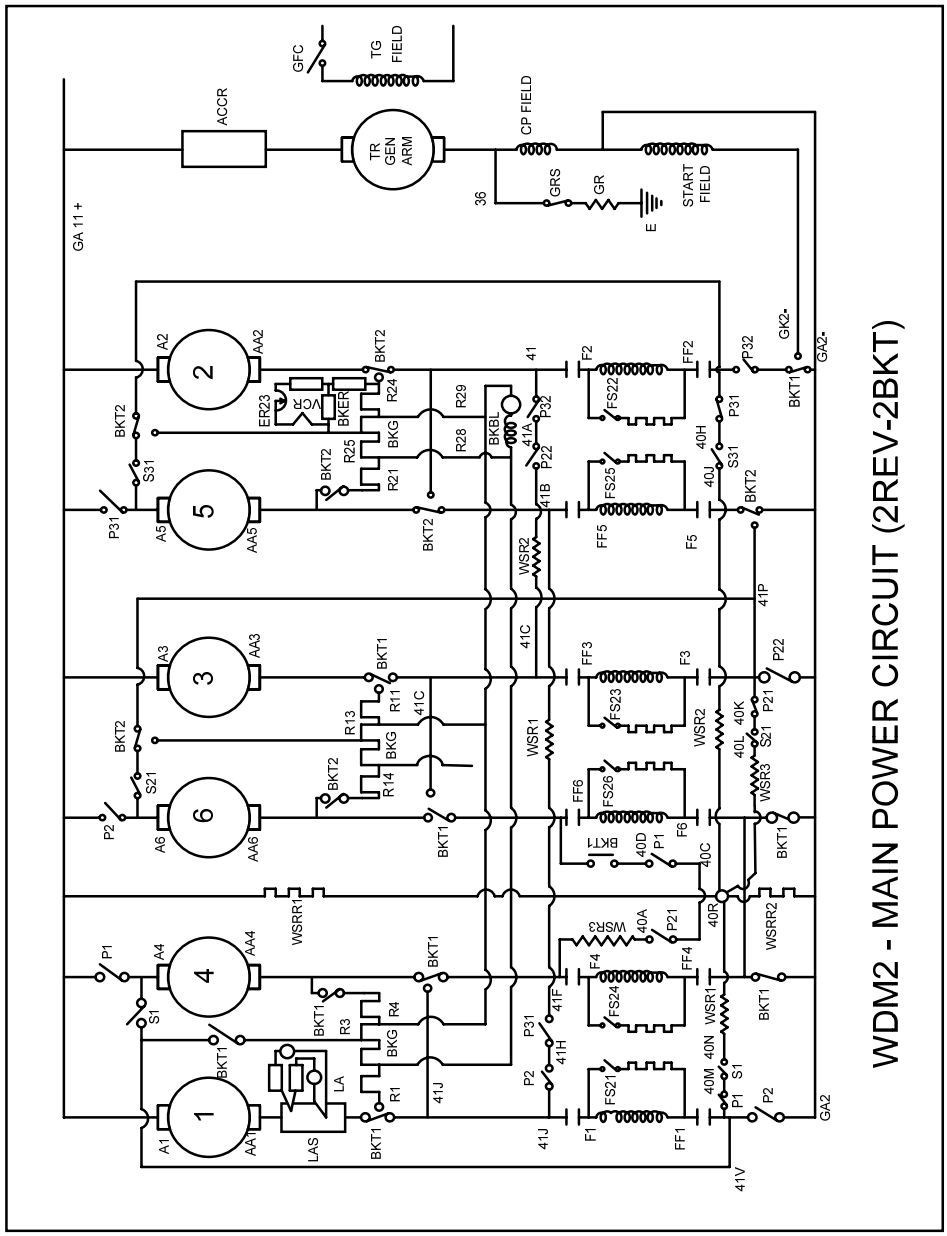
DURING 2ND TRANSITION (48KM) (TET- 207-210/2)

1. Transition relay will pick up (18A-4)
   Result :(a)FSR relay will drop
   (b) FS contactors will drop (6AA – 19H) open
   (c) GF contactor will drop (6D – 6E) open
   (d) S1, S21, S31 contactors will drop (8E – 8F) open
2. Through TR closed interlock (8E – 8L)
   Result: (a) P1, P21, P31 contactors will pick up (8L – 8S – 4)
   (b) P2, P22, P32 contactor will pick up (8E – 8K – 4)
3. Through P32 closed interlock (6C – 6E)
   Result: GF contactor will pick up

DURING 3RD TRANSITION (80 KM) (TET – 207 – 210/3)

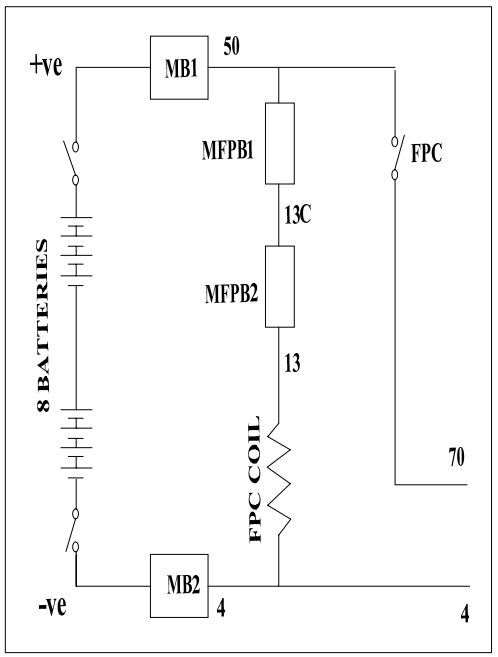
1. FSR relay will energies.
   The sequence operation like **1st transition**.

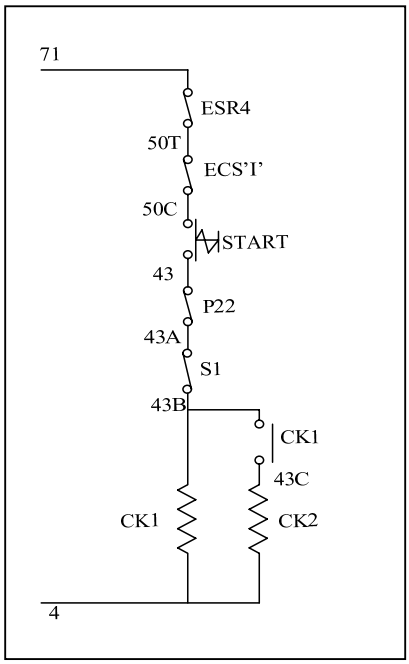
POWER CIRCUIT



TROUBLE SHOOTING (ELECTRICAL)

I. ENGINE NOT CRANKING:





A B

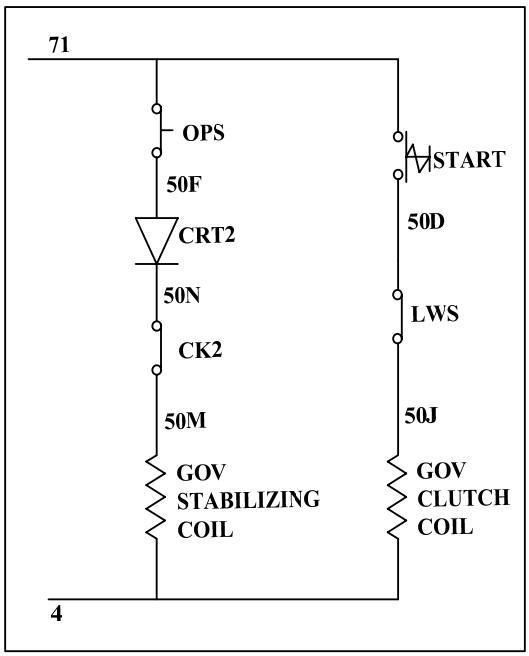
A FUEL PUMP CONTACTOR MAY BE IN OPEN CONDITION.

1. Battery knife switch may be in open.
2. MB1 may be tripped or defective. (49 – 50)
3. MB2 may be tripped or defective. (44 – 4)
4. MFPB1 may be tripped or defective (50 – 13C)
5. MFPB2 may be tripped or defective (13C – 13)
6. Fuel pump contactor coil may be in open (13,4) or defective contactor (50-70)

B. CK1 AND CK2 CONTACTORS NOT CLOSING

1. Fuel pump breaker may be tripped or defective. (70 – 71)
2. MUSD1 may be in stop or defective
3. MUSD2 may be in stop or defective
4. ESR4 N/C interlock defective (71 – 50T)
5. ECS may be in RUN or defective N/C interlock in ECS idle (50T –50C)
6. Defective start button (50C – 43)
7. Defective P22 N/C interlock (43 – 43A) or contactor may be welded.
8. Defective S1 N/C interlock (43A – 43B) or contactor may be welded.
9. Defective CK1 contactor coil (43B – 4)
10. Defective CK1 bridge interlock when CK1 is in closed (43B – 43C)
11. Defective CK2 contactor coil (43C – 4)
12. Defective traction generator.

II.ENGINE CRANKING BUT NOT FIRING:



A:

1. OPS may be struck up in pick up position (switch in open condition) or defective switch (71 – 50F)
2. CRT2 may be open circuited (50F – 50N)
3. CK2 N/C bridge inter lock may be defective (50N – 50M) or in open.
4. Amphinol plug (GE Gov.) may be slack (50M – 4)

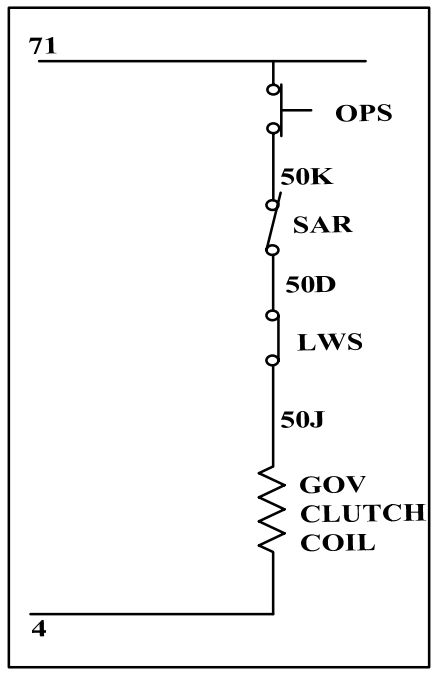
B:

1. Start button may not be closing properly or defective (71 – 50D)
2. LWS may be defective or low water in expansion tank (50D – 50J)
3. After energizing CK2 its bridge interlock may not be opened (50N – 50M)

C:

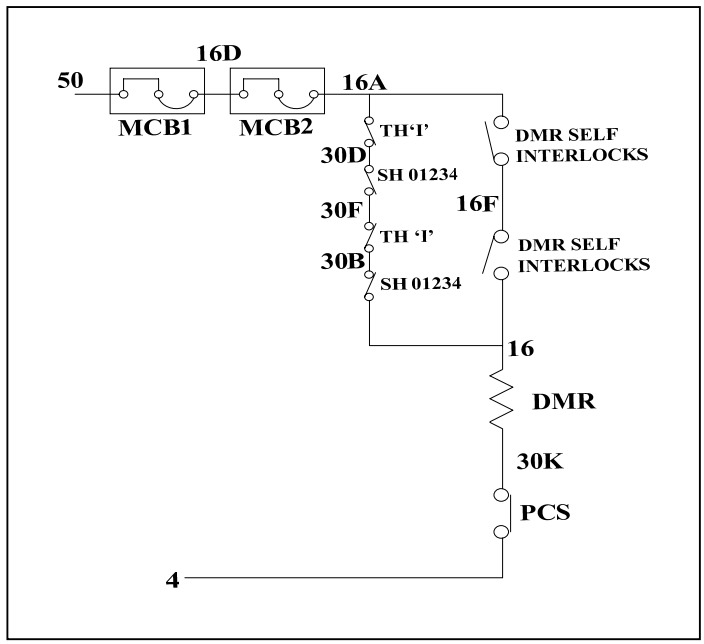
1. OST may be in tripped condition
2. Fuel oil pressure may be zero
3. Fuel pump motor may be failed.
4. Fuel booster pump may be defective.
5. Fuel booster pump love joy coupling may be failed.
6. Fuel oil system may be defective.
7. GE Governor Booster pump may be defective.
8. GE Governor Booster pump love joy coupling may be defective.
9. Governor oil may be less.
10. Governor linkage may be disconnected with fuel linkage.
11. Fuel oil level may be less.
12. W.W. Gov. low lube oil button (LLOB) may be in tripped condition.

III. ENGINE CRANKING, FIRING BUT NOT HOLDING:



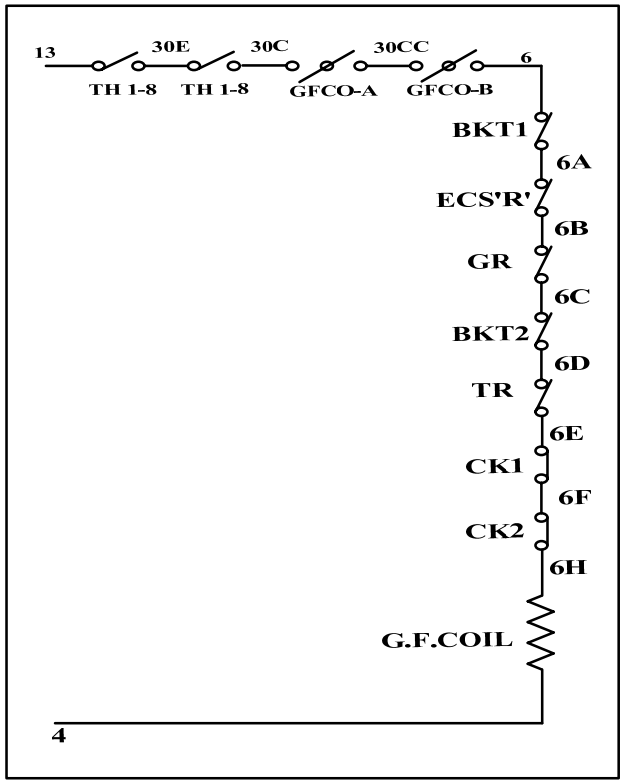
1. Lube oil pressure may be below 1.6 Kg/cm2
2. Lube oil system may be defective
3. OPS defective (Switch defective) (71 – 50K)
4. SAR closed interlock (N/O) defective (50K – 50D)

IV THROTTLE NOT RESPONDING:



1. MCB1 may be defective (50 – 16D) or tripped.
2. MCB2 may be defective (16D – 16A) or tripped.
3. TH N/C interlock defective in S.H.C.S. (16A – 30D) or TH may not be in Idle.
4. SH N/C interlocks defective in S.H.C.S (30D – 30F) or SH may not be in OFF, 1,2,3,4
5. TH N/C interlock defective in L.H.C.S. (30F – 30B) or TH may not be in Idle
6. SH N/C interlocks defective in L.H.C.S. (30B – 16) or SH may not be in OFF, 1,2,3,4
7. Defective DMR (16 –30K)
8. Defective PCS (30K – 4) or PCS may be knocked out
9. DMR self interlocks defective (16A – 16F – 16)
10. ESR`s not energizing or defective interlocks.
11. ECS may be in idle.
12. GR may be in tripped condition
13. W.W. Gov. Am phenol plug slack
14. In AC/DC locos GFOLR may be tripped

V. LOAD METER NOT RESPONDING:



With this circuit we can get generator field excitation and main generator induced EMF connected to traction motors through BKT, REV and Power contactors.

1. LOAD METER NOT RESPONDING.

This may be due to following reasons.

a. Generator field contactor not closing (GFC)
b. S1, S21, S31 power contactors not closing
c. Excitation cards slack or defective

GENERATOR FIELD CONTACTOR NOT CLOSING

Control air pressure may be less than 5 Kg/CM2

a. Throttle handle interlocks in working control stand may be defective or open
b. GF switch No. 1 or No. 2 may be defective or wire cut
c. BKT 1 or BKT 2 May not be thrown properly or its inter lock may be defective
d. ECS may be in idle or defective switch
e. GR may be tripped or defective
f. Transition relay inter lock may be defective
g. CK 1 welded or bridge inter lock may be defective
h. CK 2 welded or bridge inter lock may be defective
i. GF contactor may be defective

Note : If BKT 1 or 2 operating towards motoring properly, even then GFC not closing Pack GFC and work on wards. Before packing GFC ensure that CK 1 & CK 2 must be in deenergized condition (open).

S1, S21, S31 Power contactors not closing

a. Reversed handle not thrown properly or its interlocks may be defective
b. Reverser 1 & 2 May not be thrown properly or its interlocks may be defective.
c. BKT 1 or BKT 2 interlocks may be defective
d. ECS inter lock may be defective
e. BKR inter lock may be defective
f. TR & GFC inter lock may be defective
g. P1 power contactor may be welded or its inter lock may be defective
   S21 Alone not picking up
   P21 Power contactor may be welded or inter lock may be defective
   S31 Alone not picking up
   P31 Power contactor may be welded or inter lock may be defective

EXCITATION CARDS SLACK

a. Remove safety bar from the excitation panel.
b. Slack all the 7 Excitation cards and press for proper fitment

LOAD METER NOT RESPONDING AFTERPICKING UP 2nd TRANSITION

a. P32 power contactor may not be closed (not energized)
b. P32 power contactor interlock may be defective

LOAD METER NOT RESPONDING DURING MOTORING AFTER WORKING DYNAMIC BRAKE

1. BKT 1 or BKT 2 may not thrown properly towards motoring
2. BKT 1 or BKT 2 interlocks may be defective

LOAD METER NOT RESPONDING IN ONE DIRECTION

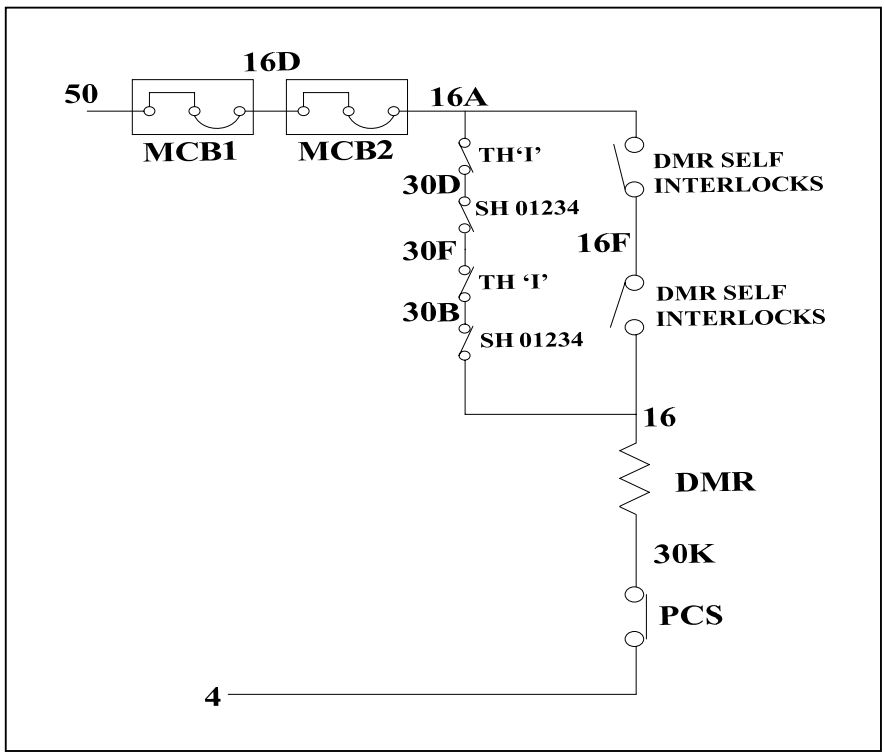
a. Working control stand reverser handle defective
b. Non working control stand with or with out reverser handle kept in one direction
c. REV 1 & 2 may not thrown properly on one direction
d. REV 1 & 2 interlock may be defective.

LOAD METER NOT INDICATING: (But power available)

1 During Loco starting (Moving) S1 power contactor is not picking up.
2 TM1 or TM4 may be defective
3 LAS may be defective
5. Load ammeters and its circuit may be defective.
6. After picking up IInd transition P2 Power contactor is not picking up.

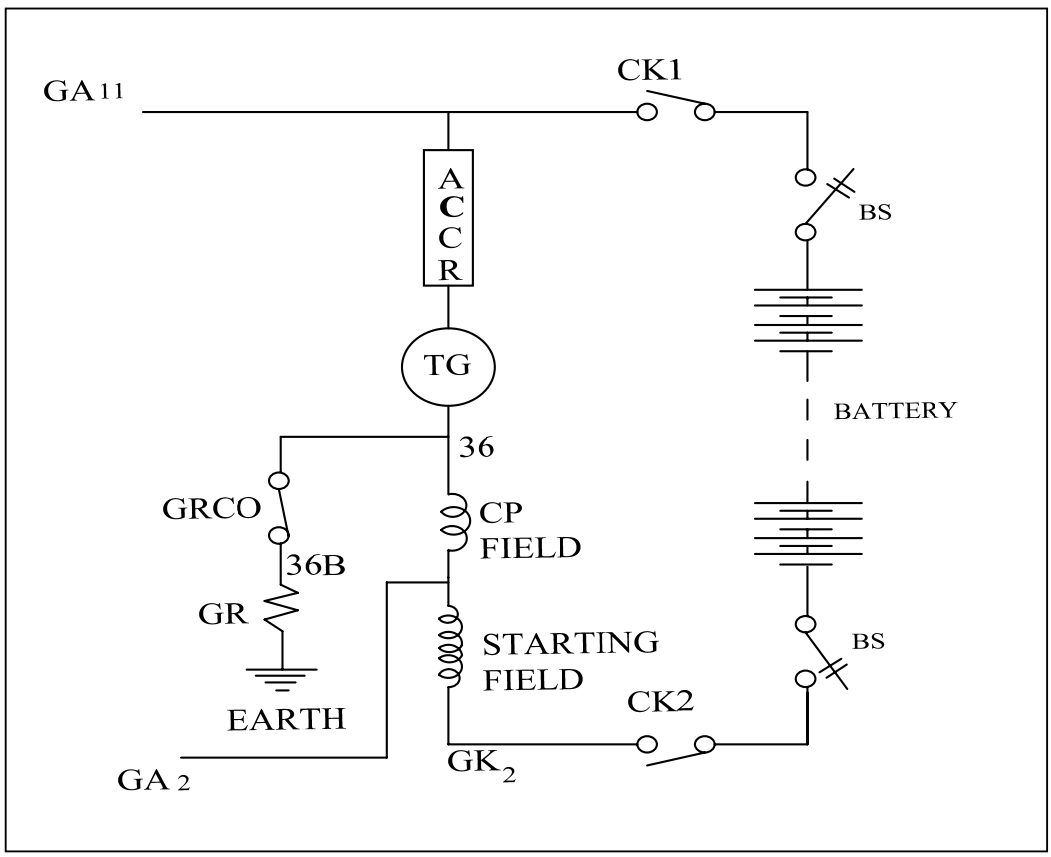
SAFETY DEVICES FITTED IN DIESEL ELECTRIC LOCOMOTIVE

(Electrical)
DEAD MAN's RELAY



1. **DEADMAN`S RELAY:** This is fitted in front panel of control compartment. When MCB1 and MCB2 switched ON, this relay will energize, through PCS. Whenever PCS is knocked out DMR will de-energize and engine will come to idle. The PCS will be operated during emergency brake application, train parting and in accidents.

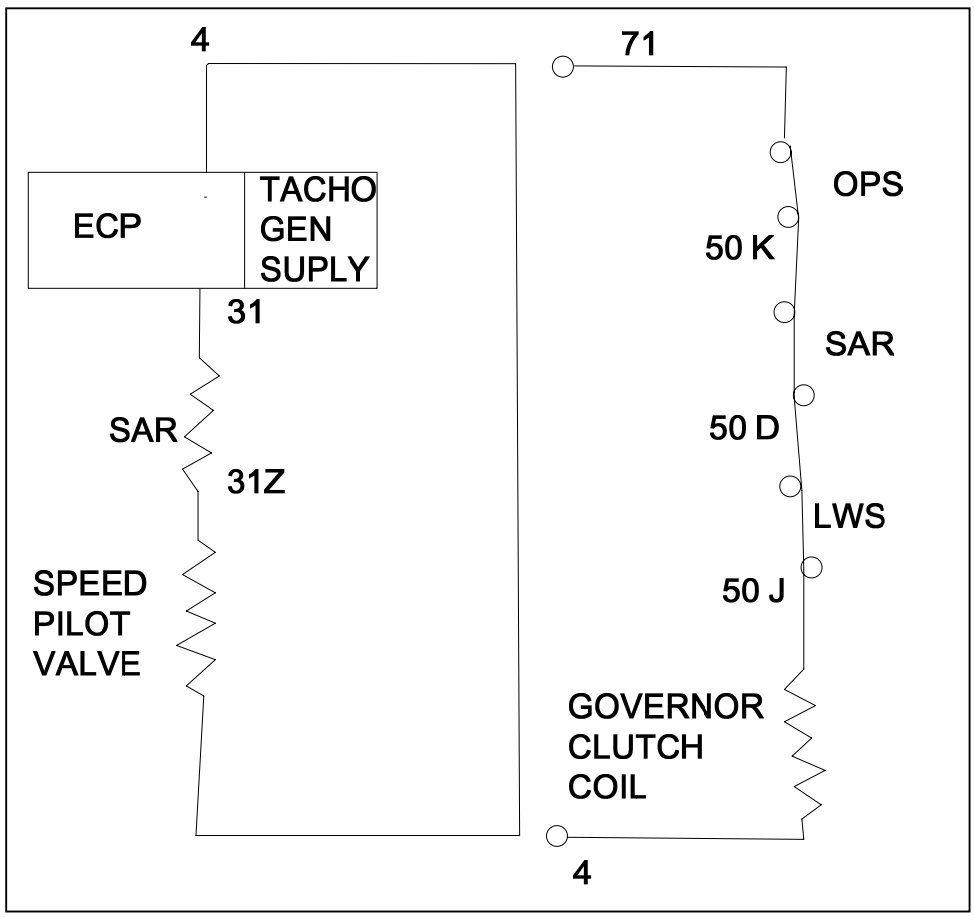
GROUND RELAY



2.GROUND RELAY: GR is fitted in front panel right side of the control compartment. When ever power circuit gets earth fault during running or whenever control circuit gets earth fault during engine starting this relay will energize.

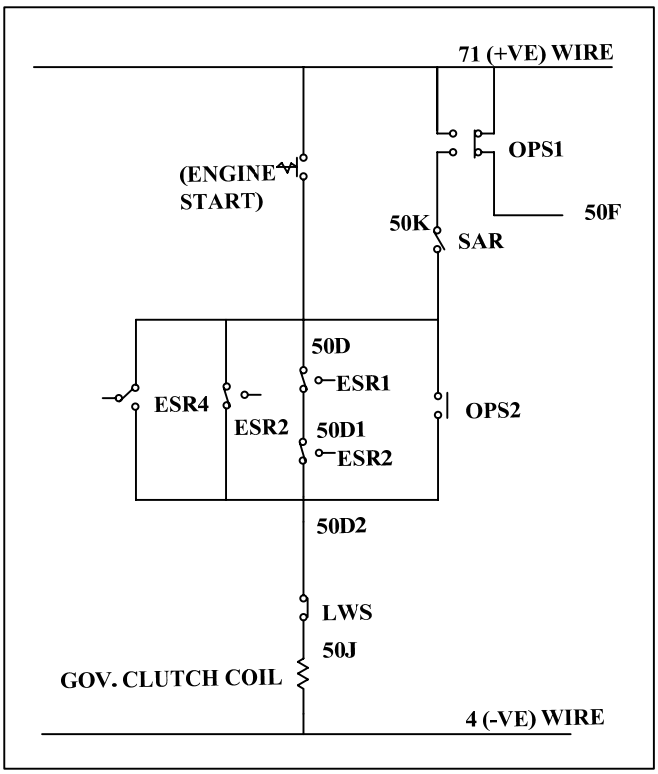
GR is connected in between –VE of main generator and locomotive body through GRCO. If any insulation punctures, leakage takes place or any bus bar or cable touches the body (ground), the leakage current flows through the GR coil and energize. With this load meter will drop to zero, engine comes to idle with GR indication and alarm.

SAFETY AUXILLIARY RELAY



3.SAFETY AUXILIARY RELAY: This relay is provided in GE governor locomotives to protect the engine (During engine running) from over speeding in case of any open circuit takes place in Governor speed coil circuit. This SAR is connected in series with speed coil (Pilot Valve). When engine is in running if speed coil current reduces below 220 Milli Amps. (from 475 Milli Amps) SAR will be de-energized. The closed interlock connected in clutch coil will open and supply will cut off to clutch coil, there by `A` Arm and `B` Arm will be separated, `B` Arm comes to no fuel position and engine will come to shut down without any indication.

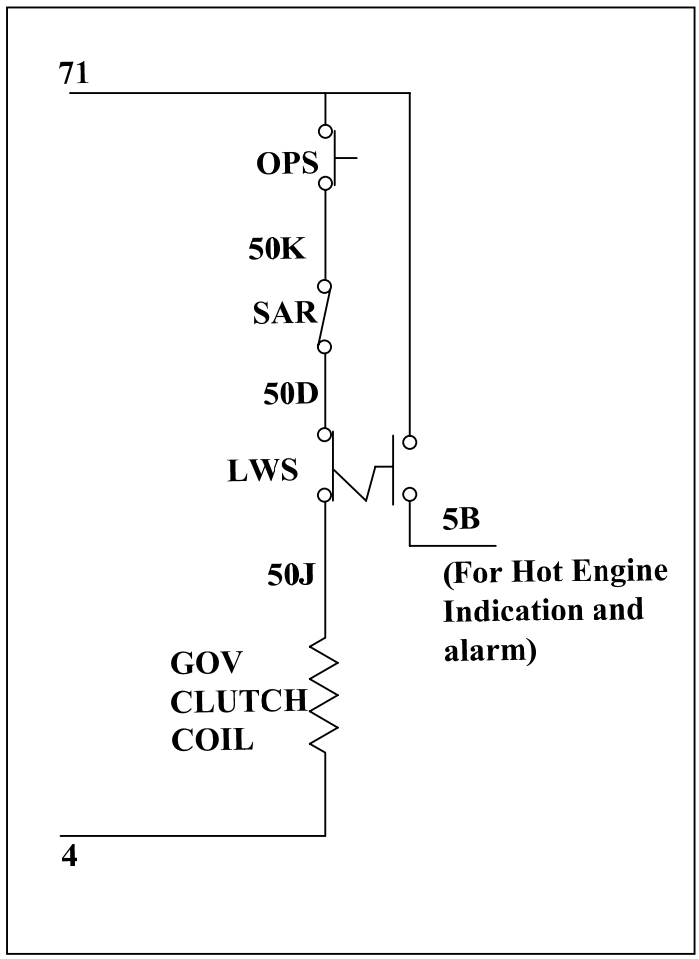
OIL PRESSURE SWITCHES



4. a.) OIL PRESSURE SWITCH 1: These are fitted in GE governor locomotives only. It is located in drivers cab. On run if TH handle is below 6th notch if lube oil pressure drops below 1.3 kg/cm2 this switch will drop. Its closed interlock will open, and clutch coil will be de-energized. There by `A` and `B` arms will separate and `B` arm will come to no fuel position. Engine will come to shut down. OPS open interlock will close and low lube oil indication with bell will come. (Audio and visual indication) .OPS picks up at 1.6 kg/cm2.

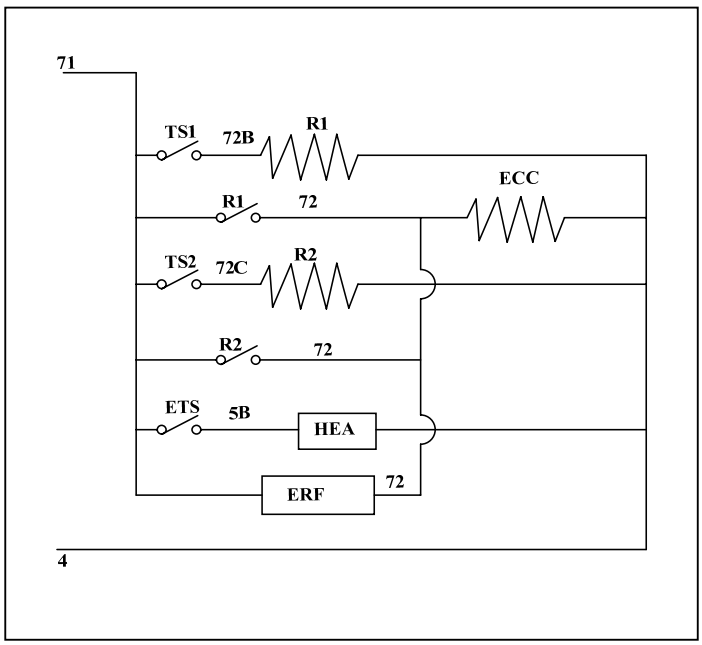
b.) OIL PRESSURE SWITCH 2: On run if TH handle is above 7th notch if lube oil pressure drops below 3.5 kg/cm2 this switch will drop. Its closed interlock will open, and clutch coil will be de-energized. There by `A` and `B` arms will separate and `B` arm will come to no fuel position. Engine will come to shut down. OPS open interlock will close and low lube oil indication with bell will come. (Audio and visual indication) .
OPS picks up at 3.7 kg/cm2.

LOW WATER SWITCH



5.LOW WATER SWITCH: LWS is fitted in cooling water system and located in compressor/expressor room. It is connected in series with Governor clutch coil by its closed switch. (If cooling water level is above 1" from the bottom of expansion tank) Whenever water level is reduced below 1" from the bottom in expansion tank, LWS will operate and its closed interlock will open and cut off supply to Governor clutch coil. `A` arm `B` arm will be separated `B` arm will come to no fuel position and engine comes to shutdown. LWS open interlock will close and hot engine indication with alarm will come. (Audio and visual indication)

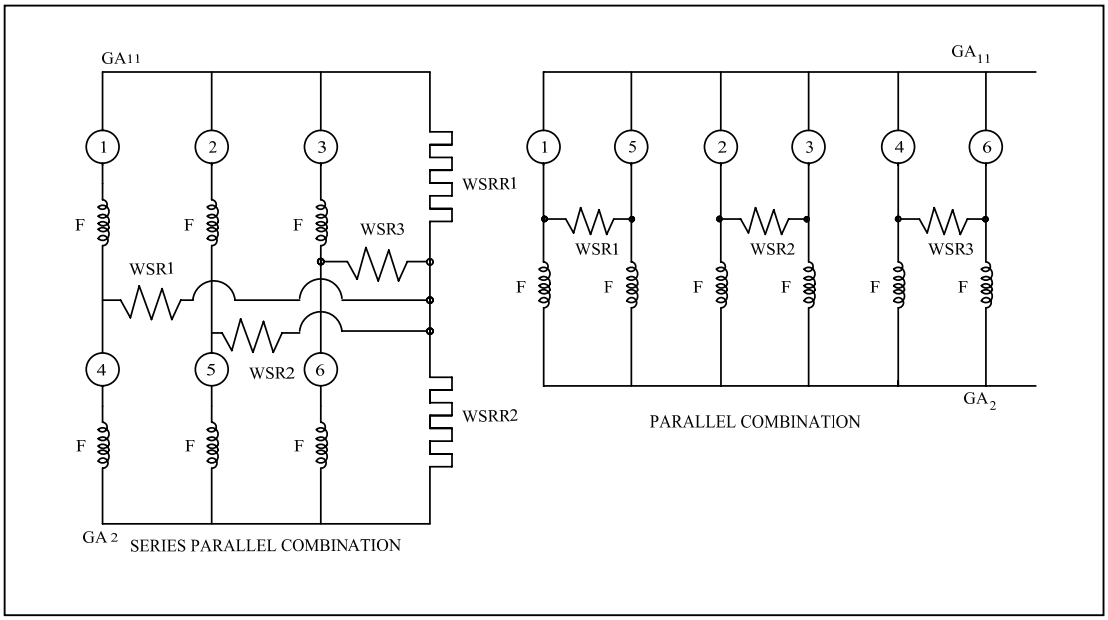
ENGINE TEMPERATURE SWITHCHES



6. ENGINE TEMPERATURE SWITHCHES: The heat generated in the engine cylinders has to be dissipated efficiently; pressurized water-cooling system is employed in the diesel engine. The cooled water is collected from the radiators and pumped through various channels in the engine block by the water pump, which is gear driven by the engine crank shaft. After exchanging the heat, the water is cooled in the radiators by forced air. Atmospheric air is drawn through the radiator FINS by the radiator fan coupled to the engine by eddy current clutch.

- At 68°c TS1 switch will close R1 operating coil will energize. R1 contactor will close and ECC will get supply. Now radiator fan will work in full speed.
- At 74°c TS2 will close R2 operating coil will energize. R2 contactor will close and ECC will get supply. Now also radiator fan will work in full speed only.
- At 90°c ETS will close and hot engine indication with alarm will come.
- If radiator fan is not working switch ON ERF. Now ECC will get direct supply bye passing entire electrical control system.

WHEEL SLIP RELAY



7. WHEEL SLIP RELAY: In the locomotive all the six wheels are powered by six individual traction motors coupled through a gear, if any one of the wheel is slipped due to loss of adhesive or not rotating due to locked axle, the wheel will skid and has to be machined. To detect the locked axle or pinion slip or wheel slipping on the track, a safety device is called WSR is provided to operate. If any potential difference takes place between any two Traction motors this relay will operate and T.G. Field excitation will be reduced (nullified) and load meter drops to zero, wheel slip indication with buzzer and auto sand application will takes place.

To identify the particular motor there are two WSR coils in each relay. One is in series parallel combination another is in parallel combination.

8.OVERSPEED TRIPPING ASSEMBLY: In case of any electric speed signals (Circuit) problem there is every chance of engine RPM shooting and damage to the engine and crankshaft. A mechanical tripping device is connected to the fuel rack when the engine RPM is increased beyond 1140 RPM the fuel racks are forcibly brought to no fuel position by tripping OSTA and engine will come to shut down without indication.

If engine is re-cranked with OSTA tripping position, engine will crank firing will not takes place resulting batteries discharging.

REASONS FOR ENGINE AUTOMATIC SHUT DOWN (WITH INDICATION)

1. Water level in Expansion Tank is reduced from the bottom below 1" and causing LWS operation. (Hot Engine indication with Alarm)
2. Lube oil pressure dropping below 1.3 kg/cm2, up to 6th notch causing OPS-1 dropping. (Low Lube oil indication with alarm)
3. Lube oil pressure dropping below 3.5 kg/cm2 in 7th & 8th notches causing OPS 2 dropping. (Low Lube oil indication with alarm)

(WITHOUT INDICATION)

4. In G.E. Governor Locos Governor Amphinol Plug slack
5. In G.E. Governor Locos Tacho Generator signal failed to Governor and causing SAR Relay dropping
6. Fuel Pump Breaker tripping.
7. Fuel Pump contactor opening.
8. MFPB-1 or MFPB-2 tripping.
9. MB-2 Breaker tripping.
10. MB-1 & AGFB together tripping.
11. Battery Knife switch open and AGFB tripping at a time.
12. Fuel Pump Motor fail.
13. Fuel Booster Pump or Governor Booster Pump failed.
14. Fuel Booster Pump Lovejoy coupling or Governor Booster Pump Love joy coupling failed.
15. Fuel Oil system defective.
16. Fuel oil very less in tank.
17. Governor Oil less in tank.
18. Governor oil pressure may be less.
19. Governor linkage may be disconnected.
20. OSTA may be tripped.

REASONS FOR AUTOMATIC ENGINE COMING TO IDLE (WITH INDICATION)

1. G.R. may be operated (explosive or non-explosive P.G.)
2. GFOLR may be operated (AC/DC Locos).

(WITHOUT INDICATION)

3. DMR may be de-energized:
    a) PCS-2 knocked out due to A-9 emergency.
    b) P2 may be closed due to BP dropping below 4.4 kg/cm2 in Brake pipe.
    c) PCS-1 knocked out due to vacuum train pipe vacuum dropped.
    d) Fire man emergency may be operated.
    e) MCB-1 or MCB-2 may be tripped.
    f) DMR self interlocks may not be having proper contact(Defective)
4. ERR Relay may be de-energized (in W.W. Gov. Loco)
5. Governor Amphenal plug slack. (in W.W. Gov. Loco).

REASONS FOR CONTINUOUS WHEEL SLIP

1. Locked axle.
2. Traction motor defective.
    a) Pinion slipped
    b) Loose connections any where in power circuit(T.M).
    c) Open Circuit in TM internal connections
    d) TM Bearing seized.
3. Any FS contactor may be welded.
4. During 1st and 3rd any one FS contractor not pick up.
5. Paper or tape between any contactors (PC, BKT, REV, FS contractor).
6. WSR resistance 1 or WSR resistance 2 may be open circuited causing continuous wheel slip below II nd transition (From starting of Loco)

Identification of defective traction motor

In series parallel picking up of WSR relay	In parallel picking up of WSR relay	Defective Traction motor
WSR 1	WSR 1	No. 1
WSR 2	WSR 2	No. 2
WSR 3	WSR 2	No. 3
WSR 1	WSR 3	No. 4
WSR 2	WSR 1	No. 5
WSR 3	WSR 3	No. 6

REASONS FOR POWER GROUND.

1. In power system some where earthed.
2. Power contactors fluttering
3. Transition pickup & dropout at the same time.
4. Control Air pressure may be improper.
5. Water or oil entered in electrical machinery.
6. Cables or bus bars rubbing any where to loco body.

I PACKING OF FPC CONTACTOR IN NORMAL.

1. Open battery knife switch and switch OFF all the breakers.
2. Pack the contactor with wooden wedge.
3. Switch on BS and all the breakers.

II PACKING OF FPC CONACTOR IF COIL IS IN BURNT CONDITION.

1. Remove 13 +ve wires in FPC contactor coil terminal and join all the 13 wires with conducting wire outside the terminal.
2. Remove 4 –ve wires in FPC Contactor Coil terminal and join all the 4 wires with conducting wire outside the terminal

III. PACKING OF GF CONTACTOR IN NORMAL.

Note:- Before packing ensure CK1 & CK2 must be in open condition (De-Energized)

1. Keep TH-I, REV Neutral, both GFC-OFF and ECS – idle.
2. Pack the GF contactor with wooden wedge.
3. ECS - run both GFCO-ON, REV- Required direction SA9 – full application, A9-minimum and open TH-1 notch.

Load meter will shoot to abnormal and jerk will be experienced, after few seconds LM will come to normal.

IV. Packing of GF contactor If coil is in burnt condition.

After doing item (1) in above, GF coil 6H terminal wires to be removed and join all the wires with conducting wire outside the terminal.

GF coil 4 terminal wires to be removed and join all the wires with conducting wire outside the terminal.

Continue above procedure item 2&3 in "III" for GF packing.

Note :-II nd transition will not pickup with GF contactor packing

(a.). After getting more than 48 Km speed close the TH to idle and open, now IInd transition will pickup.

(b.). Close the TH to idle and apply manual transition (irrespective of Loco speed) open TH IInd transition will pick up.

(c). DB should not be used.

S. No	Description	WDM2	WDM3A	WDG3A	WDP1	YDM4/4A	WDP4	WDG4
1)	Service	Goods/ Coaching	Goods/ Coaching	Goods	Coaching	Goods/ Coaching	Coaching	Goods
2)	Length in Meters	17.12	17.12	19.15	16.09	13.82	21.24	21.24
3)	Weight in Tonnes	112.8	112.8	123	80	72	117	128.5
4)	MPS in KMPH	120	120	100	120	96	160	100
5)	Engine RPM in Idle	400	400	400	400	400	269	269
6)	Engine RPM (8th Notch)	1000	1050	1050	1000	1100	904	904
7)	OSTA Tripping RPM	1110-1150	1160-1200	1160-1200	1110-1150	1210-1250	960-1045	960-1045
8)	Air Filtration	Panel type/Cyclonic with paper type secondary filters	Cyclonic with bigger size of filters and paper type secondary filters	Cyclonic with bigger size of filters and paper type secondary filters	Cyclonic with bigger size of filters and paper type secondary filters	Air maize oil bath filters	Cyclonic type primary and Baggy type secondary filters	Cyclonic type primary and Baggy type secondary filters
9)	Brake System	28LAV1 & IRAB1	IRAB1	IRAB1 & 28LAV 1	28LAV1	28 LV 1	CCB	CCB
10)	Fuel Oil Tank Capacity	5000	5000	6000	3000	3000	6000	6000
11)	Lube Oil Sump Capacity	910	1110	1110	760	530	950	1457
12)	Cooling Water Capacity	1210	1210	1210	1210	530	1045	1154
13)	Type of Governor	GEG/WWG	GEG/WWG	GEG/WWG	GEG/WWG	WWG	WWG	WWG
14)	Input to Traction HP	2400	2750	2750	2000	1200	3726	3726

S. No	Description	WDM2	WDM3A	WDG3A	WDP1	YDM4/4A	WDP4	WDG4
15)	Tractive effort Maximum in KGs	28050	28050	37884		18935	27550	53000
16)	Adhesion	27%	27%	30.8%		26.3%	43%	43%
17)	Weight transfer to wheels through	Centre Pivot 60% Side bearer 40%	Centre Pivot 60% Side bearer 40%	Side load pads 100%	Side Spring Groups 100%	YDM4 CP-60% SB-40% YDM4A SB-100%	Side rubber resilient pads 100%	Side rubber resilient pads 100%
18)	Axle Load(Tonnes)	18.8	18.8	20.5	20	12	19.5	21.42
19)	Bogie	Cast	Cast	Fabricated	Fabricated	Cast	HTSC	HTSC
20)	Gear Ratio (Pinion:Bull Gear)	18:65	18:65	18:74	18;65	19;92	17;77	17:90
21)	Traction Motor arrangements	LLR/LRR	LLR/LRR	LLL/RRR	LR/RL	LLR/LRR	LL/RR	LLL/RRR
22)	Electrical Transmission type	DC/DC	AC/DC	AC/DC	AC/DC	DC/DC	AC/AC	AC/AC
23)	Cranking done by	Generator working as Motor	Exciter and Aux. Generator working as Motors	Exciter and Aux. Generator working as Motors	Exciter and Aux. Generator working as Motors	Generator working as Motor	Two Starter Motors (DC)	Two Starter Motors (DC)
24)	Loco Drive	Right Hand	Left Hand	Left Hand	Left Hand	Right Hand	Left Hand	Left Hand

S.No	Description	WDM2	WDM3A	WDG3A	WDP1	YDM4/4A	WDP4	WDG4
25)	Master controller	Alco model Handle with TH/DB and reverser handle	UIC model hand wheel with TH/DB and reverser handle	UIC model hand wheel with TH/ DB selector and reverser handle	UIC model hand wheel with Throttle and reverser handle	Alco model Handle with TH/DB and reverser handle	Handle with TH/DB and reverser handle	Handle with TH/DB and reverser handle
26)	Transition	3 (with Field Shunting)	1 (No Field Shunting)	1 (No Field Shunting)	1 (with field shunting)	1 (SP to P) 1 (Field shunting)	No Transition	No Transition
27)	Dynamic Brake Facility	Available	Available	Available	Not Available	Available	Available	Available
28)	TM Isolation	Defective TM can be Isolated	Defective TM can be Isolated	Defective TM can be Isolated	Defective TM can be Isolated	Defective TM can be Isolated	Particular Truck to be Isolated	Particular Truck to be Isolated
29)	In case of TM Isolation D.B.	Will not function	Will not function	Will not function	Not Applicable	Will not function	Will function for working truck	Will function for working truck
30)	Type of Engine	4 Stroke V-16 Turbo super charged diesel engine	4 Stroke V-16 Turbo super charged diesel engine	4 Stroke V-16 Turbo super charged diesel engine	4 Stroke V-12 Turbo super charged diesel engine	4 Stroke , 6 Cylinder inline, Turbo charged diesel engine	2 Stroke V-16 Turbo charged diesel engine	2 Stroke V-16 Turbo charged diesel engine

S.No	Description	WDM2	WDM3A	WDG3A	WDP1	YDM4/4A	WDP4	WDG4
31)	Type of Turbo used	720A/ABB/ NAPIER	ABB/ NAPIER	ABB/ NAPIER	ABB/ NAPIER	350C	GM	GM
32)	Working of Turbo	Exhaust gas driven Turbo	Exhaust gas driven Turbo	Exhaust gas driven Turbo	Exhaust gas driven Turbo	Exhaust gas driven Turbo	Gear/Exhaust gas driven Turbo	Gear/Exhaust gas driven Turbo
33)	Type of Truck	Side bearers centre pivot co-co type	Side bearers centre pivot co-co type	Side Load pads, Center Pivot, co-co type	Side Spring Groups, Center pivot, BO-BO Type	Tri-mount/ Tetra Mount co-co type	Side Load pads, Center Pivot, co-co type	Side Load pads, Center Pivot, A-A-1, 1-A-A
34)	Expressor / Compressor cooling	Air cooled	Air cooled	Air cooled	Air cooled	Air cooled	Water cooled.	Water cooled.
35)	Fuel Injection System	Through separate fuel injection pumps and injectors	Through separate fuel injection pumps and injectors	Through separate fuel injection pumps and injectors	Through separate fuel injection pumps and injectors	Through separate fuel injection pumps and injectors	Direct fuel injection by Unit Injectors	Direct fuel injection by Unit Injectors
36)	Engine lube oil system	One lube oil pump, gear driven for entire lube oil system	One lube oil pump, gear driven for entire lube oil system	One lube oil pump, gear driven for entire lube oil system	One lube oil pump, gear driven for entire lube oil system	One lube oil pump, gear driven for entire lube oil system	4 lube oil pumps, 3 gear driven, 1 Electrical motor driven	4 lube oil pumps, 3 gear driven, 1 Electrical motor driven

S.No	Description	WDM2	WDM3A	WDG3A	WDP1	YDM4/4A	WDP4	WDG4
37)	Cooling Water System	One Water pump, gear driven, one radiator fan driven by Engine through ECC	One Water pump, gear driven, one radiator fan driven by Engine through ECC	One Water pump, gear driven, one radiator fan driven by Engine through ECC	One Water pump, gear driven, one radiator fan driven by Engine through ECC	One Water pump, gear driven, one radiator fan driven by Engine through ECC	Two water pumps gear driven, two radiator fans driven by ELE. Motors	Two water pumps gear driven, two radiator fans driven by ELE. Motors
38)	Lube oil consumption per every 100 Lts of Fuel Oil Consumption	1.5 Liters	1.5 Liters	1.5 Liters	1.5 Liters	1.5 Liters	0.5 Liters	0.5 Liters
39)	Minimum Radius of Curvature (Meters)	73.2	73.2	73.2	73.2	45.75	64.92	64.92
40)	Minimum continous Speed (KMPH)	18	22.8			11.6	22.5	22.5

AC / DC TRANSMISSION LOCO MOTIVES
(WDG 3A (WDG 2), WDM 3A (WDM 2C) & WDP 1 LOCOMOTIVES)

1. CKR1 & CKR2 :

Location : Front panel left side Purpose : whenever start button is pressed these relays will be energized and makes to disconnect Generator circuits in both Auxiliary Generator and Exciter Generator during working as motors and also energizing CKC contactor.

2. CKC :

Location : Back panel

Purpose : It makes to pick upCK1, CK2 & CK3 contactors.

3. CK1, CK2, & CK3 :

Location : Front panel right side bottom.

Purpose : Battery supply will be connected to Auxiliary & Exciter Generators to work as motors for engine cranking.

4. TDR :

Location : Front panel left side.

Purpose : Whenever CK3 cranking contactor closes this relay will be energized and delays generator circuits of both Auxiliary and Exciter for 1.5 seconds extra after releasing start button (After dropping CKR1& CKR2, CK1, CK2 & CK3).

5. EXCITATION PANEL :

In 6th and 7th excitation cards numbers 492 & 493 are upgraded to suit the output voltage of traction alternator.

6. TRANSITION PANEL :

There will be only two cards (i.e. 207 & 210-1) and only one transition is available i.e. series-parallel to parallel.

7. GR2 (CONTROL GR) :

Location : Front panel left side :

Purpose : whenever engine is starting, if there is any control earth fault this relay will get energize and it will not allow the engine for cranking, by de-energizing CKC.

8. GRCO2 (GROUND RELAY CUT-OUT SWITCH) :

Location : Front panel left side.

Purpose : for isolating the GR2 from the circuit on emergency.

9. RECTIFIER PANEL :

Location : Back panel (IN WDM3A & WDP1), In between back panel and Main Generator (IN WDG3A)

Purpose : To convert Main Generator AC voltage to DC voltage for traction motors. It is cooled by FTTM blower and in some locomotives separate motor driven blower is provided.

10. GFOLR (GENERATOR FIELD OVER LOAD RELAY) :

Location : Front panel right side :

Purpose : Whenever over current drawn by the generator field or rectifier panel (due to defective), this relay will get energized and the following changes will takes place.

a. GF contactor will drop and load meter comes to zero.
b. Engine comes to idle.
c. Over load indication with bell.

It will have two coils :

1. Operating coil : For operation
2. Resetting coil : For resetting automatically.

11. ACCR (ARMATURE CURRENT CONTROL REACTOR) :

Location : Near rectifier panel.

12. LAS (LOAD AMMETER SHUNT) :

Location: Side of BKT.

13 . BKT & REV :

1. Only one BKT and one REV will be there.
2. P32 & P22 location is inter changed.
3. In place of BKR relay, BKR1, BKR2 and BKR3 relays are provided.
4. During DB only 5 power contactor will pick up.

14. BSR (BATTERY SAFETY RELAY) :

Available only in W.W. Gov. Locos.

Location : Front panel right side top.

Purpose : If MUSD is in STOP position, this relay will be energized and will not allow the engine for re-cranking. There by batteries discharge will not take place.

15. EPG Governor:

On SH control stand toggle switch (Main switch), In nose compartment pressure switch and in compressor room Governor will be there.

WDM3A, WDG3A, WDP1, GE GOVERNOR

ENGINE STARTING CIRCUIT

Cranking:

1. Put on 'BS' (Battery knife switch) in nose compartment.

   Result:

   (a) Battery positive supply readily available near MB2, CK1 and Aux. Generator Armature.

   (b) Battery negative supply readily available near MB1, CK3 and battery discharge lamp will glow (through Aux. Generator armature, VRCLS, Aux. Generator fail LED and through battery ammeter)

2. Put on MB2 on front panel.

   Result:

   Battery positive supply charged up to MFPB1 and FPC contactor fixed tip (49-50).

3. Put onMB1 on front panel.

   Result:

   Battery negative supply charged to entire control circuit (44F-4).

4. Put on MFPB1in SH driver desk (control stand).

   Result:

   Battery positive supply charged up to MFBP2 (50 – 13C).

5. Put on MFPB2 in LH driver desk.

   Result:

   FPC Coil will be energized (13-4) FPC contactor will be closed (50-70)CCEM LED will glow (70 - 70A).

6. Put on CCEB on front panel.

   Result:

   CCE motor starts working (70A-4) CCEB lamp will goes off.

7. Put on FPB breaker on Front Panel (70-71).

   Result:

   Fuel pump motor stats working (71-4) .

   Engine starting lamp will glow through OPS N/C – CK3 N/C

   (71-50F-50N-50P).

8. Keep ECS 3 times idle to run.

   Result:

   LLOB indication with SR energizing and alarm gong will operate (50F-1A-1B) bell (13-2)

9. Press start button.

   Result:

   a. CKR1 & CKR2 coils will energize through (ESR4 N/C (71-50T), ECS IDLE (50T-50C), start button (50C – 43), P22 N/C (43-43A), S21 N/C (43A-43B).

   b. CKC will pickup through GR2 N/C (71-43E) and CKR1 closed inter lock (43E-43C).

   c. CK1 & CK2 contactors will energies through CKC closed contactor (71-43D).

   d. CK3 will pick up through CK1 closed interlock (71-43SS), CK2 closed interlock (43SS-43KK).

   e. TDR pick up through CK3 closed interlock (71 – 71AA).

10. Engine will crank through CK1, CK2 & CK3 contactors closing.

Firing:

1. When FPB breaker switched on stabilizing coil will energize through OPS N/C switch (71-50F), CK3 N/C interlock (50N-50P-50M–4).

2. When start Button pressed clutch coil will energize through start button (70-50D), LWS N/C switch (if sufficient water) (50D-50J-4).

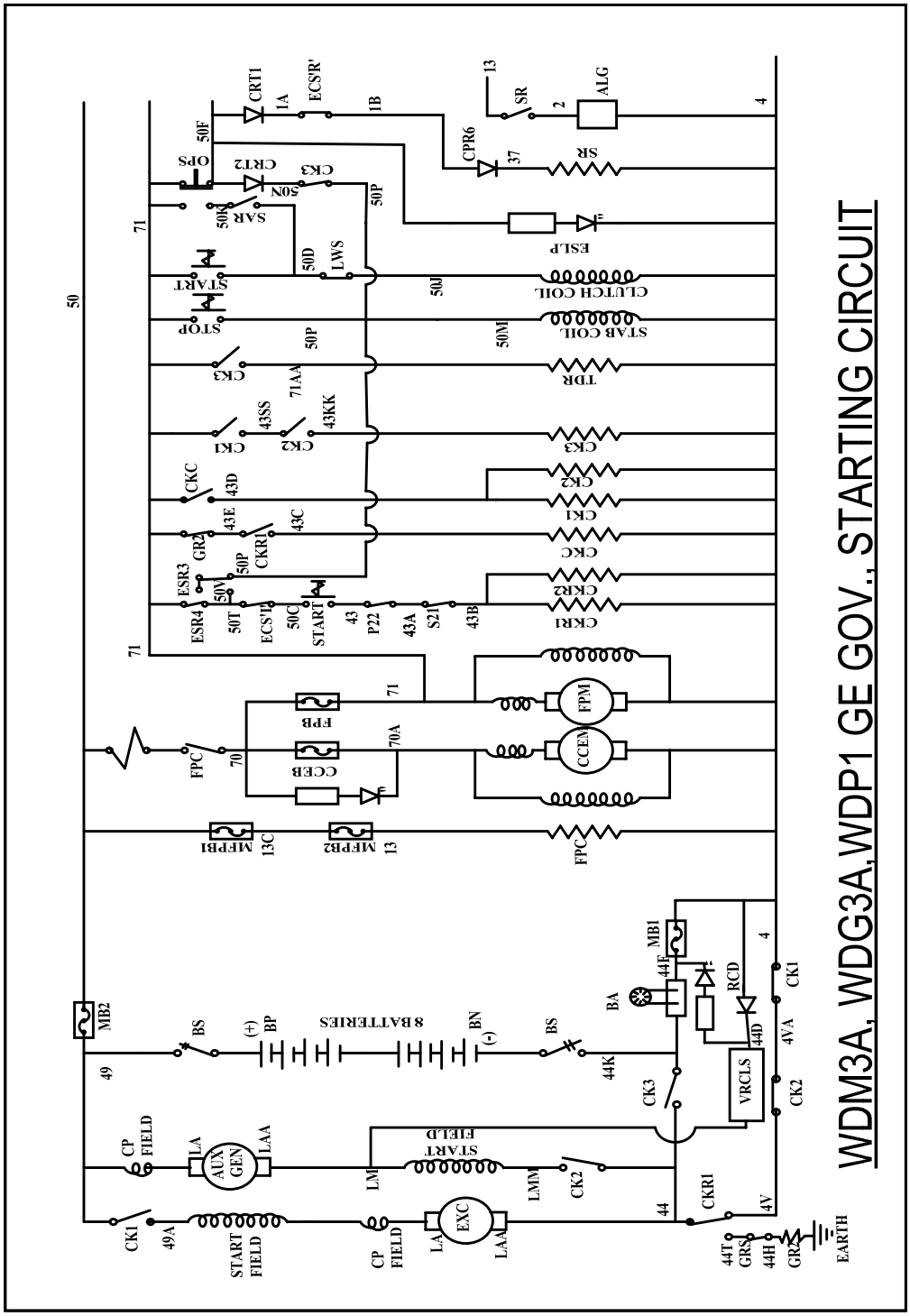
3. When CK3 relay picks up stabilizing coil will de-energize (50N-50M)

Holding:

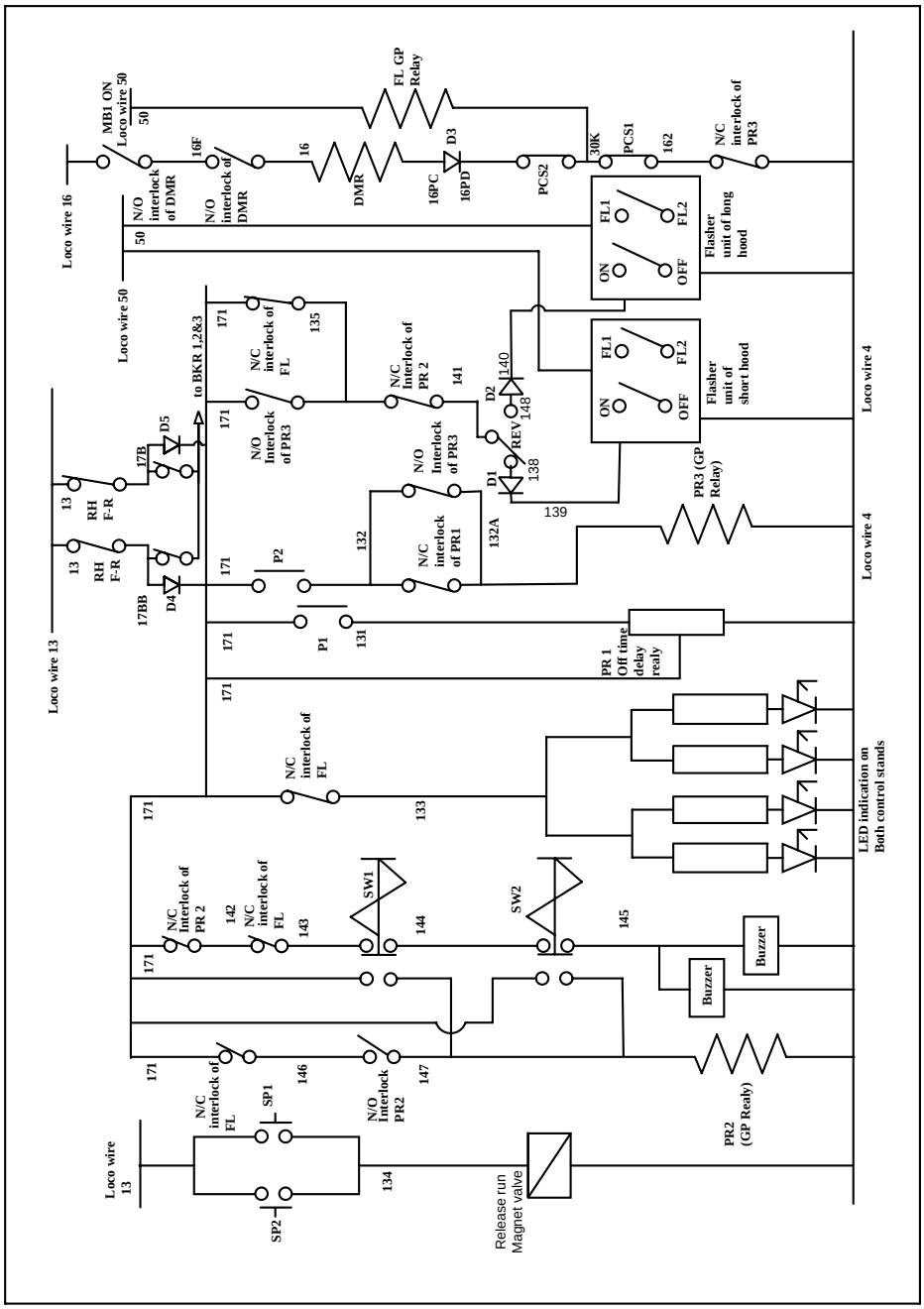
1. When ever lube oil pressure reaches 1.6 kg/cm2 OPS will pick up (71-50K)

2. When ever engine speed reaches more than 220 RPM SAR relay will energize and SAR interlock will close (50K-50D).

Now clutch coil will energize permanently. Now release the start button. CKR1, CKR2, CKC, CK1, CK2, CK3 will drop but TDR will not drop. After 1.5 sec TDR will drop, till such time bell will ring with contact tip welded indication.(Auxiliary and Exciter generator circuit will be in open)


WDM3A, WDG3A,WDP1 GE GOV., STARTING CIRCUIT
CRT1
ECSR'
SR
ALG
CPR6
OPS
CRT2
CK3
SAR
ESLP
START
STOP
CLUTCH COIL
STAB COIL
TDR
CKC
CKR1
CKR2
ESR3
ESR4
GR2
CKR1
ECST
START
FPB
CCEB
FPM
CCEM
FPC
MFPB1
MFPB2
MB2
MB1
BS
BP
BN
8 BATTERIES
BA
RCD
VRCLS
CK1
CK2
CK3
CKR1
CP FIELD
AUX GEN
START FIELD
EXC
EARTH
GR1
GR2

AUTO FLASHER LIGHT CIRCUIT



DEVICES IN AUTO FLASHER LIGHT SYSTEM

SWITCHES :

(a) P1
(b) P2
(c) PCS 1
(d) PCS2
(e) SW1 & SW2
(f) SP1 & SP2

RELAYS:-

a. FL Relay
b.PR_3 Relay
c. PR_2Relay
d.PR_1Relay

ROTEX VALVE: CHOKE:- 5.5mm
QUICK CHARGE of BP (Magnet valve $\frac{3}{4}$" pipe)

Switches position:-

P1 closes below 4.5 kg/cm^2 BP
P1 opens above 4.8 kg/cm^2 BP
P2 closes below 4.4 kg/cm^2 BP
P2 opens above 4.7 kg/cm^2 BP
PCS1 closes below 6.5 kg/cm^2 MR from HB5 valve
PCS1 opens above 7.5 kg/cm^2 MR from HB5 valve
PCS2 closes above 4 kg/cm^2 BP
PCS2 opens below 2.8 kg/cm^2 BP

RELAYS POSITION:-

FL, PR2 & PR3 General Purpose Relays
PR1 Time Delay Relay (Off Time Delay for 60 sec after disconnecting the supply)

I. **In Pure Air Brake Formation, if BP dropping other than A9 operation like Accident, Derailment, Parting, BP pipe cut, brake van (guard) emergency brake application, chain pulling and fireman emergency application, Auto Flasher System Starts Working.**

1. Whenever BP pipe pressure drops below 4.4 kg/cm^2, P2 switch will close (171-132)
2. Through N/C interlock of PR1 relay (132-132A), PR3 Relay will pick up (132A, 4).
3. N/O interlock of PR3 relay will close (132-132A). Now PR3 relay will get supply from its self interlock (Even though PR1 relay interlock opens PR3 relay will not drop)
4. Auto flasher light glowing through

    a. N/O interlock of PR3 relay will close (171-135)
    b. N/C interlock PR2 relay (135-141).
    c . REV forward closed interlock(141-138).
    d. D1 Diode (138-139) front flasher light will glow. 139- 4
    e. REV in reverse closed interlock (141-148).
    f. D2 diode (148-140) rear flasher light will glow 140, 4.
5. N/C Interlock of PR3 relay will open and makes DMR and FL Relay to drop. Engine comes to idle.(162-4)
6. Through N/C interlock of FL Relay (171-133), in both control stands LED Indication will come.
7. Buzzer working through

    a. N/C interlock of PR2 relay (171-142).
    b. N/C interlock of FL Relay (142-143)
    c. N/C switch of SW1 (143-144).
    d. N/C switch of SW2 (144-145), buzzer will operate.

II. In vacuum brake formation auto flasher light starts working due to vacuum train pipe vacuum drops below 38cms other than A9 operation like accident, derailment, parting, vacuum pipe open, brake van (guard) emergency brake application, chain pulling and fireman emergency application.

1. Whenever train pipe vacuum drops below 38cms other than A9 operation HB5 valve will operate.
2. Whenever HB5 valve operates it allows MR air to go to PCS1 and makes to knock out (switch to open) (30k,162). This makes DMR and FL relay to drop and engine comes to idle.
3. Auto flasher light will glow Through

    a. N/C interlock of FL relay (171-135).
    b. N/C interlock PR2 relay (135-141).
    c. REV forward closed interlock(141-138)
    d. D1 Diode (138-139) front flasher light will glow (139,4).
    e. REV in reverse closed interlock (141-148).
    f. D2 diode (148-140) rear flasher light will glow (140,4).

4. Through N/C interlock of FL Relay (171-133), in both control stands LED Indication will come.

5. Buzzer working through

    a. N/C interlock of PR2 relay (171-142).
    b. N/C interlock of FL Relay (142-143)
    c. N/C switch of SW1 (143-144).
    d. N/C switch of SW2 (144-145), buzzer will operate.

III RESETTING PROCEDURE OF AUTO FLASHER LIGHT

1. Switch on normal flasher light from FL units (**if Flasher light is required)**
2. Press either SW1 switch, in short hood control stand (143-144) or SW2 switch, in Long hood control stand (144-145) will open and makes buzzer to stop.
3. Through SW1 or SW2 closed switch (171-147), PR2 relay will pick up (147,4).
4. Through N/C interlock of FL relay (171-146)

    a. N/O interlock of PR2 relay will close (146-147) and PR2 relay will energize from its self interlock also. (When SW1 or SW2 opens due to button in released condition, PR2 relay will be in permanent energized condition.)

5. N/C interlock of PR2 relay (171-142) will open and buzzer will not operate(even though SW1 or SW2 switch closes due to button in released condition).

6. N/C interlock of PR2 relay (135-141) will open and Automatic flasher light will not work (normal flasher light is in working).

LED INDICATION ON BOTH CONTROL STAND WILL GLOW BECAUSE FL RELAY IN DROPPED CONDITION.

IV. Whenever A9 is operated action taking place in Auto flasher light system

1. With A9 operation whenever BP drops below 4.5 kg/cm^2, P1 switch will close (171-131).
2. PR1 time delay relay will pick up (131,4)
3. N/C interlock of PR1 relay, will open (132-132A) and will not allow PR3 relay to pick up even though P2 switch is closed.

NOW, BRAKES WILL APPLY, AUTO FLASHER LIGHT, INDICATION, BUZZER WILL NOT WORK AND ALSO ENGINE WILL NOT COME TO IDLE.

V. Whenever A9 is operated to Emergency position action taking place in Auto flasher light system.

1. With A9 Emergency application BP pressure drops below 2.8 kg/cm^2 PCS2 switch will open (16PD-30K).
2. Only DMR will de energize and engine comes to idle. Emergency brakes will apply. Auto flasher light, indication and buzzer will not operate.

VI. Whenever required fast charging of BP.

1. Either SP1 or SP2 button to be pressed (13-134) from any control stand.
2. Magnet valve will energize (134,4) and makes BP charging with $\frac{3}{4}$" pipe including 5.5mm choke.

TROUBLE SHOOTING IN AUTO FLASHER LIGHT SYSTEM.

1.In auto flasher light system P1 and P2 switches are going to operate number of times during train working (WHEN EVER A9 is operated for train brake automatically B.P is going reduce from 5 kg/cm^2 to 4.4 kg/cm2, if A9 is kept in released position for train working BP is going to increase from 4.4 kg/cm2 to 5 kg/cm2 because of the above operations P1 & P2 Switches will operate number of times and more over difference in operation is only 0.1 kg/cm2). Because of above reason at any time either P1 or P2 may go for mal-functioning. If it goes for mal-function engine will come to idle and loco may get failed. To avoid failure isolate AFL through isolation switch (if available) or disconnect 171(which is available in AFL unit). Work with normal flasher light to reach destination. (Home shed).

TWIN BEAM HEAD LIGHT

(WITH 24V HALOGEN LAMPS AND DC-DC CONVERTER)

INTRODUCTION:

The Twin Beam Head light has been produced in Indian Railways by Railway Board/RDSO to achieve higher illumination at lower power and to eliminate dependency on non-standard 32V incandescent Head Light lamp. The 24V halogen lamps used in this system is an automotive industry standard with easier availability. The idea of twin beam is to have both lamps connected in parallel so that in the event of one lamp failure the other lamp keeps glowing.

The DC-DC converter used in this system is 72V DC to 24V DC, 500 W connected from the battery. Further, a complete standby unit is housed inside the same cabinet for necessary backup incase of any failure. (Operation by change over switch mounted in front of the DC-DC converter).

Replacement of damaged bulb:

At long hood side head light, open the back lid from inside the Loco by opening the door lock. Identify the defective lamp. Pull out the wire loom by holding 3-way nylon connector, press the lamp holder a little inwards and rotate anti-clockwise. The spring loaded holder will pop out. Remove the old lamp.

Observe that there is a notch on the reflector body, and a small raised portion on the halogen bulb rim. Put back the old bulb 2/3 times to understand its matching.

If fitted in mis-matched position, the pre-focusing effect will get disturbed resulting in low lumen output and the dimmer light instead of pointing downwards will point anywhere.

After practicing with old bulb remove the new bulb from the box fitted on the back door by unscrewing one knurled lock nut by hand and fold the bulb retaining plate. Then pull out one new bulb and close the bulb retaining plates by screwing the knurled lock.

Connect back the wire loom.

Put a new bulb in the holder.

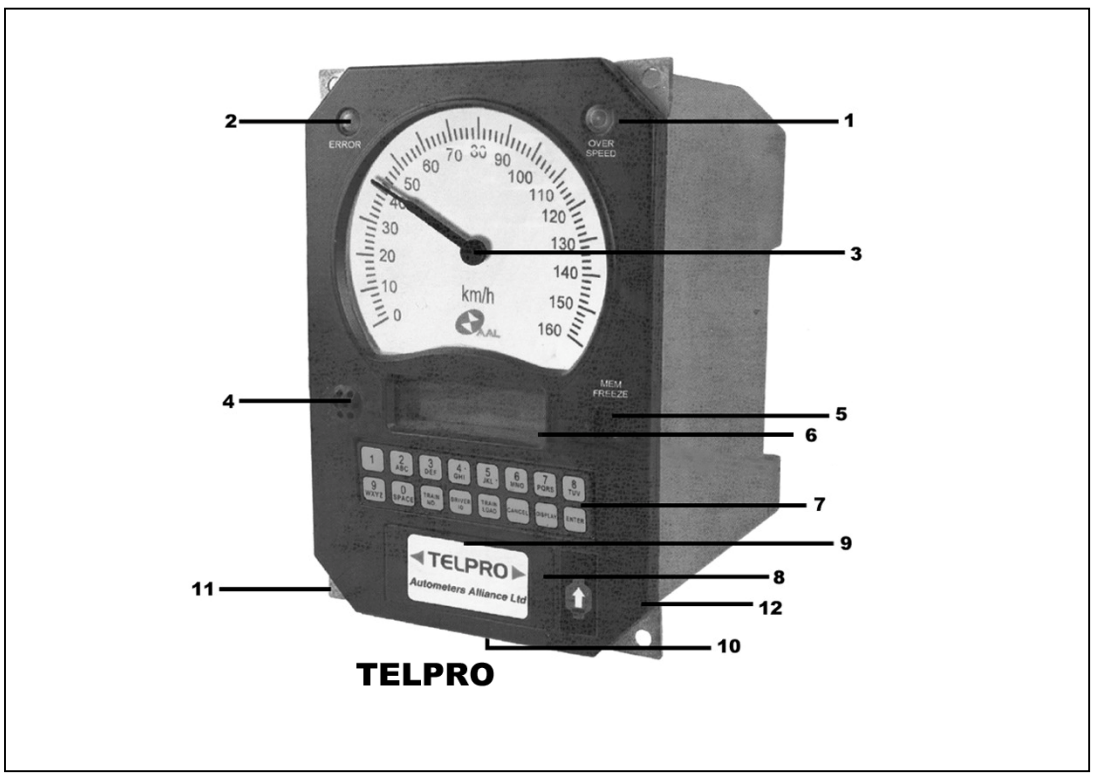
SPEEDOMETERS

AUTOMETERS ALLIANCE LTD
TELPRO-DL

Display functions :

- Analog speed indication
- 16 x 2 Alphanumeric LCD display.
- Audio and visual over speed alarm status indication.
- Display of time, Odometer reading, date, train No, Driver ID Train load, wheel diameter, maximum speed alarm, loco No, digital speed, memory free (in percentage), distance traveled by present driver (DT by PD),error messages , memory freeze indication (MF) and stepper motor indication(SE).

Detailed view of the front panel of **TELPRO** is shown in the figure:



TELPRO

PARTS :

SL No	Display units and controls	Functions
1.	Over speed indication LED	Indicates speed crossing the set over speed limit
2.	Error indicator LED	Indicates memory full, external memory absent and fault in TELPRO system.
3	Analog speed display assembly	Displays speed in KMPH
4	Buzzer	Produces audio alarm with over speed indication
5	Memory freeze switch(In side glass cover)	To stop recording in short - term memory in case of accident/emergency.
6	LCD Display	Displays time, date, speed, distance and other parameters
7	Key Board	To set various parameters by pressing keys, also to display these parameters
8	Memory card connector	For compact flash memory card connection.
9	9 Pin D- type male connector	Used for RS 232 communication and speed pointer setting.
10	Push-to-on switch	Used for configuration and parameter setting.
11	Door assembly	To prevent unauthorized access to the system.
12	Lock assembly	To prevent unauthorized access to the system

Display Functions available:

- Speed on analog display (Pointer)
- Error indicator LED for displaying error along with the digital display
- Over speed indicator LED.
- LCD display is used to display the following parameters: -
    1. Time
    2. Odometer reading
    3. Date
    4. Train No

5. Driver ID
6. Train Load
7. Wheel diameter
8. Max. Speed alarm
9. Loco No
10. Digital speed
11. Memory free (In %)
12. Distance traveled by present driver (DT by PD)
13. Error messages
14. Memory freeze indication (MF)
15. Stepper motor error indication (SE)
16. Display also provides assistance in configuration of the system through the keypad.

Keyboard and its functions:

1	2 ABC	3 DEF	4 GHI	5 JKL	6 MNO	7 PQRS	8 TUV
9 WXYZ	0 SPACE	TRAIN NO.	DRIVER ID	TRAIN LOAD	CANCEL	DIS PLAY	ENTER

No Of Keys : 16
Colour : Black and Yellow

Pictorial view of key board and its inscriptions as used TELPRO is shown above. Descriptions of each key provided on the keyboard are as follows;

Key "**0** to **9**" and **A** to **Z** — They are used to enter alphanumeric values while setting parameters. Some keys are provided with other functions also. These functions are given below;

Key "**0**" — Back light illumination setting is done through this key

Key "**1**" — Date is displayed as this key is pressed

Key "**9**" — Dial illumination setting is done through this key

Key "**Train No**" — Used to set the train No

Key "**Driver ID**" — Used to set the Driver ID

Key "**Train Load**" Used to set the train load in tons. Also used while setting is done in parameter mode or configuration mode.

Key "**Cancel**" Used when a wrong value that has been entered is to be cancelled.

Key "**Display**" Displays the set parameter value and used in setting display parameter in configuration mode.

Key "**Enter**" Save the changes that are made in various parameters.

Memory freeze switch

Memory freeze switch is present inside the front panel of master behind the glass window. As this switch is pressed ON after breaking the glass further recording in the short-term memory is halted.

Facilities	**Medha**					**Auto meter**			**Laxven**
	MRT 912	MRT 912M	MRT 912 C	MRT 918VI	MRT 918VII	RT9	SP 90S	TELPRO	LAXVEN 2000
Graph roll availability	Yes	Yes	No	No	No	Yes	No	No	No
Memory capacity	No	6 Hrs	60 Days	60 Days	90 Days	No	30 Min.	60 Days	60 Days
Memory freezer switch	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Driver/train ID entry Facility	No	No	Yes	Yes	Yes	No	No	Yes	Yes
Digital speed display	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes

AUTO METERS Rt-9-98

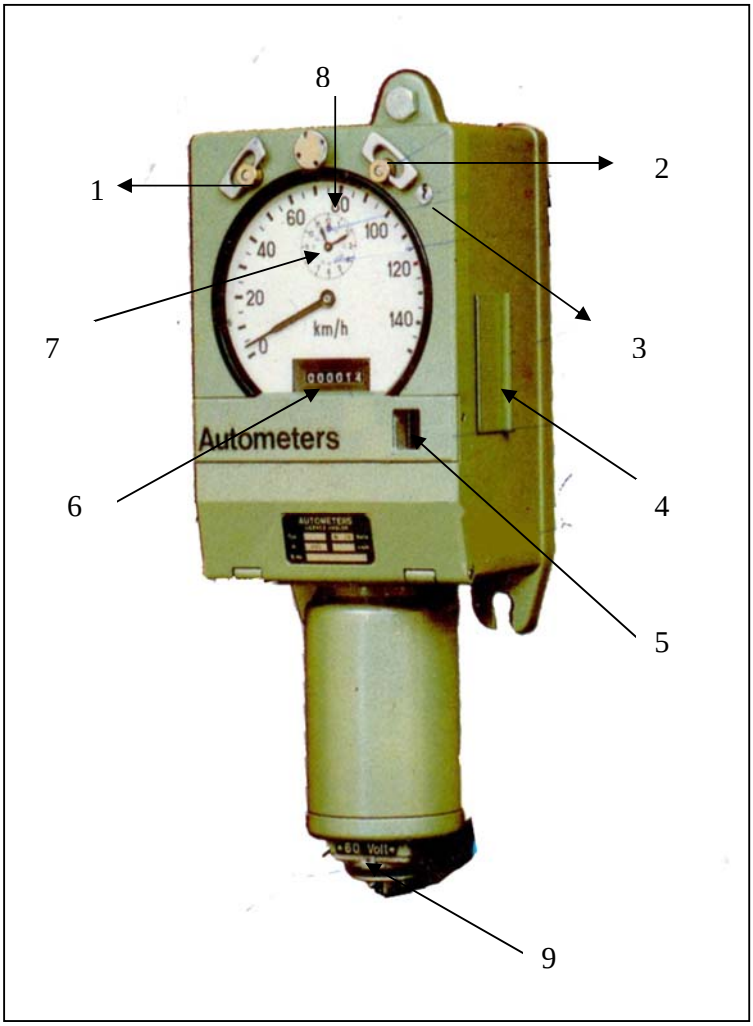


Chart Recorder Parts

1. Clock winding key
2. Time setting key
3. Lock
4. Chart Inspection Door
5. Glass window
6. ODO Meter
7. Clock Dial
8. AM-PM Indicating Dot
9. Plug connection

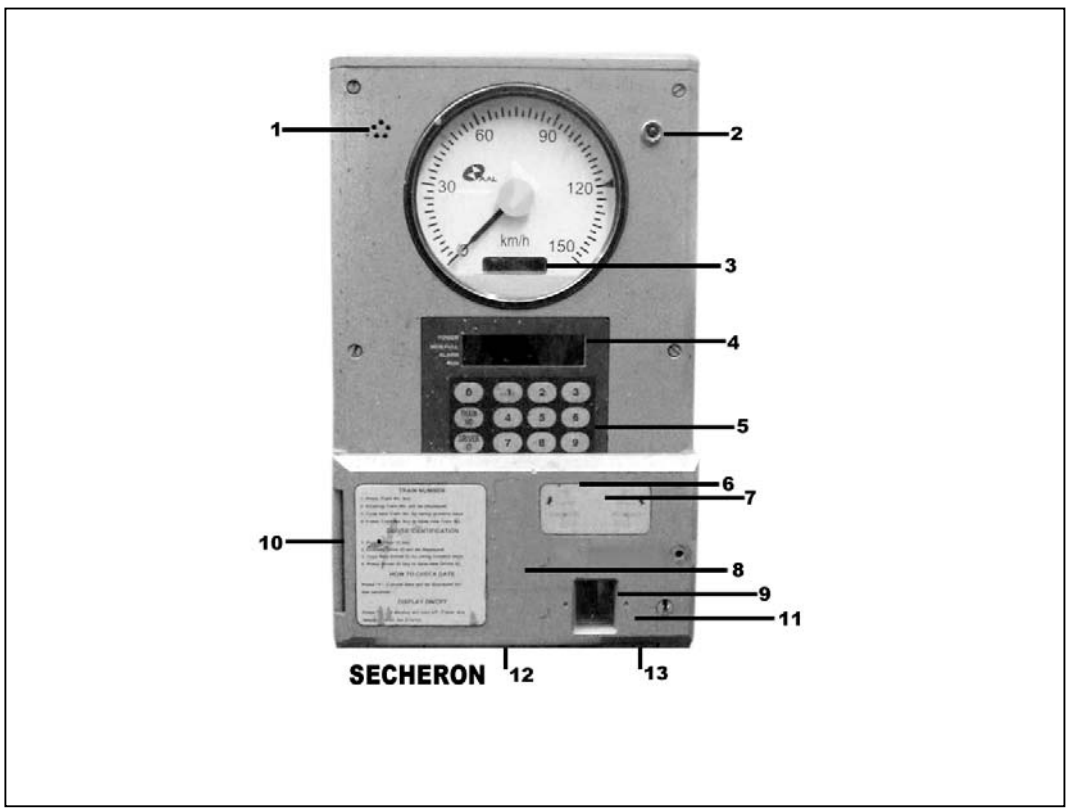
Instructions :

1. Wind the clock every morning at 9 hrs.
2. Time adjustment only after winding the clock.
3. From 00:00 Hrs to 12:00 Hrs White Dot and 12:00 Hrs to 00:00 Hrs Blue Dot
4. In window if Red lines are noticed, chart is ending.

AUTOMETERS SECHERON

SP – 90S

Indicator with static memory, SP-90S has the following features:



PARTS :

1. Over speed alarm
2. Over speed LED
3. Six Digit Odometer
4. Display
5. Key Board
6. Loco No. Thumbwheel switch
7. Max. Speed thumbwheel switch

8. Wheel wear thumbwheel switch
9. Memory freeze switch
10. Short term memory module
11. Power on Switch
12. 10-pin connector
13. 14-Pin connector

(a) **Speed indication**

Needle for analog speed indication is driven by highly reliable stepper motor

(b) **Odometer**

Six digit Odometer indicates the total distance covered by the loco in k.m.

(c) **Display**

Time is displayed in hour: minute: second format. Also four red LEDs indicate:

a. Power: This LED continuous to glow when power to the system is turned on.
b. Memory Full: This LED kept for future use .
c. Alarm: This LED will glow when Loco speed crosses the over speed limit set by the over speed thumb wheel switches.
d. Run: This LED blinks to indicate that the system is functioning normally. **This does not have any link with loco is running or not.**

(d) **Key Board**

Driver ID and Train No. can be fed in the system with help of this key board. To enter Driver ID and Train No. follow the following instructions which are also printed on the system. Also time can be set using this key board. But this function is behind lock and key and can be performed by shed staff only. Instructions for setting the time are also given below.

Caution: Any data entry through key board should be done only when the loco is stationery. Any fiddling in the running condition will disturb the normal functioning of the system.

TIME & DATE

1. Press SET TIME key
2. System will ask for hour. Correct it & then press EXEC Key.
3. System will ask for minutes, correct it and press EXEC key.
4. Now system will ask for date in sequence dd/mm/yy.
5. Press EXEC key to save new date & time.

TRAIN NUMBER

1. Press Train No. key
2. Existing Train No. will be displayed.
3. Type new Train No. by using numeric keys.
4. Press Train No. key to save new Train No.

DRIVER IDENTIFICATION

1. Press Driver ID key
2. Existing Driver ID will be displayed.
3. Type new Driver ID by using numeric keys.
4. Press Driver ID key to save new Driver ID.

HOW TO CHECK DATE

Press "1", current date will be displayed for few seconds.

DISPLAY ON/OFF

Press "0", all display will turn off. Press any key to turn on the display.

(e) **Memory Freeze Switch**

This switch is covered by a glass window when the front door is closed. In case of any accident brake the glass and turn ON this switch. This will freeze the data in short term module and no further data will be recorded even if the Loco is moved. Thereafter data in the module can be extracted in the shed to know the exact conditions when the accident occurred.

MICRO PROCESSOR BASED SPEED – TIME – DISTANCE – INDICATING AND RECORDING SYSTEM (LAXVEN)

LOCO MOUNTED EQUIPMENTS

1. Pulse generator (Optical)
2. Junction box & cable assembly (J.B)
3. Microprocessor based speed recorder cum indicator unit (RCI)
4. Speed indicator (IND)

PARAMETERS

1. Date in DD:MM:YY format
2. Distance traveled by the locomotive in KM/Hr
3. Speed limit in KM/Hr
4. Wheel dia meter in mm
5. Memory fill in %
6. Train No.
7. Driver No.
8. Train load in tones
9. Locomotive No.
10. Dynamic brake status
11. Dynamic brake duration
12. Dynamic brake distance
13. Coasting status
14. Coasting duration
15. Coasting distance
16. Current distance by a present driver

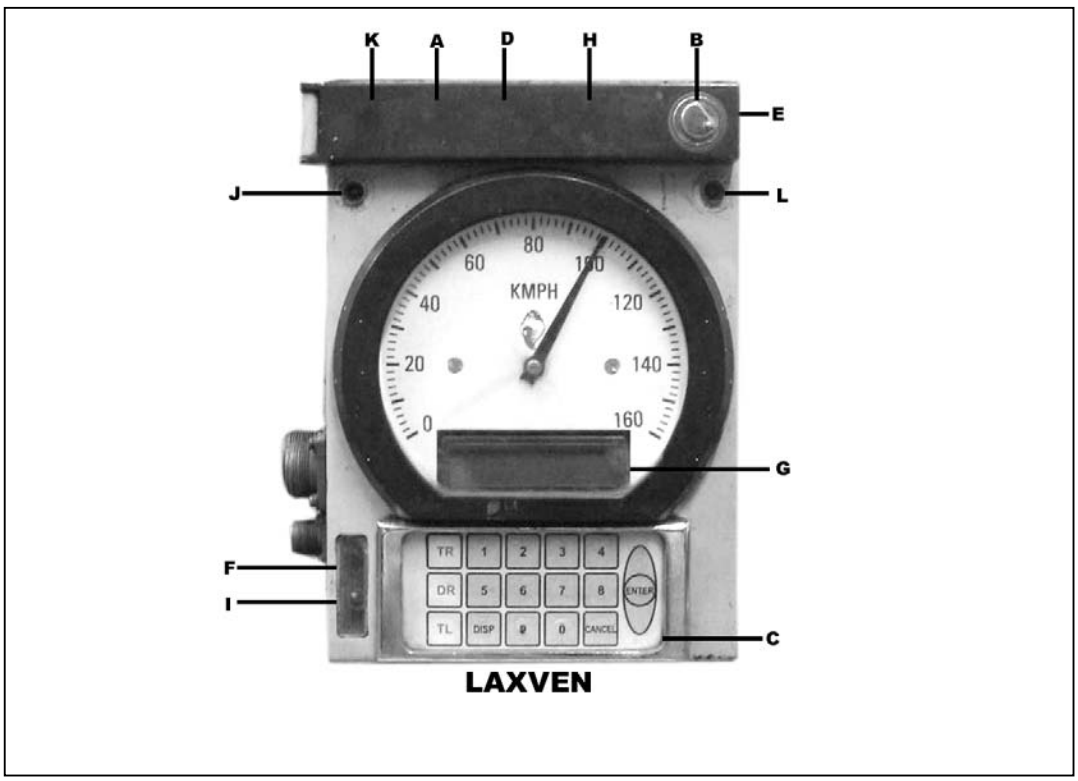
DRIVER LEVEL PROGRAMMING:

Driver is supposed to operate the key pad only when the locomotive is in still/Half condition. As the driver is provided with the key, he can not open the lid of memory compartment, he is having direct access to key board to enter his identification, Train No. and train load in the following sequence.

Each operation is given 8 Sec. time. If the driver opts to change the one of three parameters he has to operate the keys with in 8 Sec. from the last press. If he does not press with in the specified time old values will be retained.

1. Driver code can be entered by the driver
2. Train No. can be entered
3. Train load can be entered in Tonnes

During programming, the indicating unit shows a display of "PLEASE WAITPROCESSING" indicating that recorder cum indicator unit is in programming mode.



PARTS :

A. PROGRAMME SWITCH
B. LOCK
C. KEY PAD
D. PCMCIA CARD
E. PROTECTIVE COVER
F. MEMORY FREEZE SWITCH
G. DISPLAY
H. RS 232 PORT
I. MEMORY FREEZE LED
J. OVER SPEED LED
K. PROGRAMME ON LED
L. SYS/MEM FAIL LED

MEMORY FREEZE

A Memory freeze switch is provided on the front panel of the speed recording system. A breakable glass is provided on the switch, incase the fine memory is to be freezed , to access the written data and not to be over written, then the option is to brake the glass and MEMORY FREEZE switch should be put to ON condition. Once the switch is ON fine memory is freezed and system will not write or access the fine memory area till the memory freeze s2witch is put to OFF condition as long as the MEMORY IS FREEZED the fail indication appears on the display and a red LED indication will appear in the memory freeze compartment.

Only fine memory will be freezed during the memory freeze switch is in ON condition. Long term memory will however be written.

MEMORY FULL

As per the specification if the data in the memory is more than 85 % of occupancy, then the systems should indicate the user as full memory and the caution the user to down load the data at the earliest to avoid the loosing the earlier data because of the looping format of the data structure.

During this time SYS/FAIL lights up and this is an indication to the user to verify the memory capacity on the display and the necessary action to be taken to down load the data.

In this case the SYS/FAIL does not mean the system is failed, but a warning signal to the user. Please do not mis- understand this point.

MEDHA METERS

MRT 912

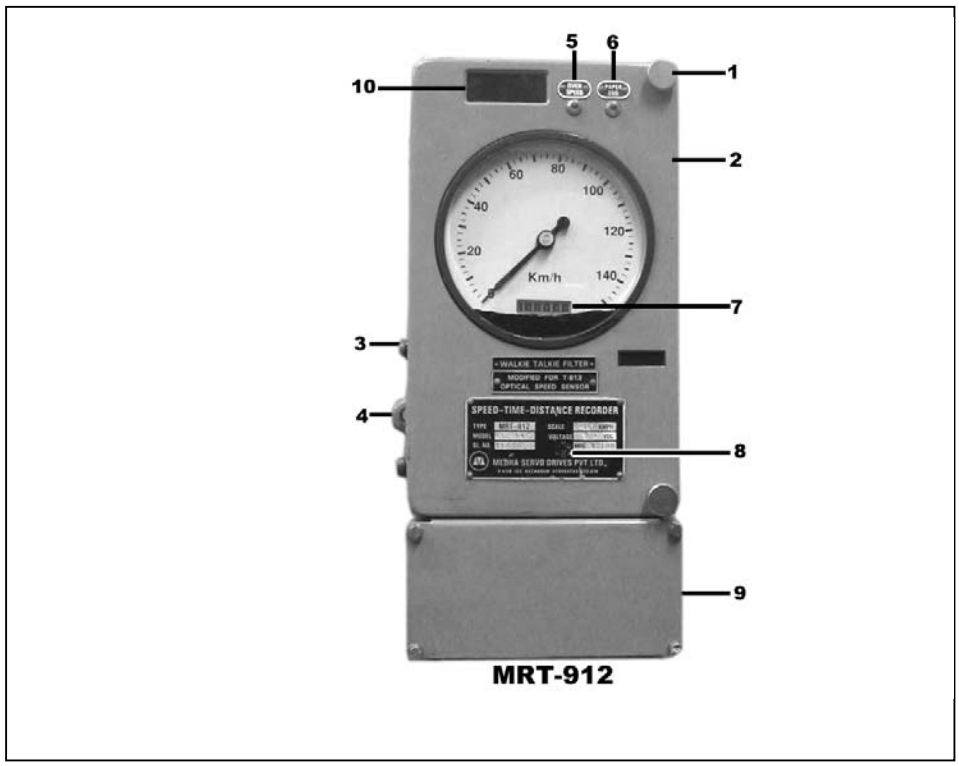


Chart Recorder with Indicator Memory Back up

Parts

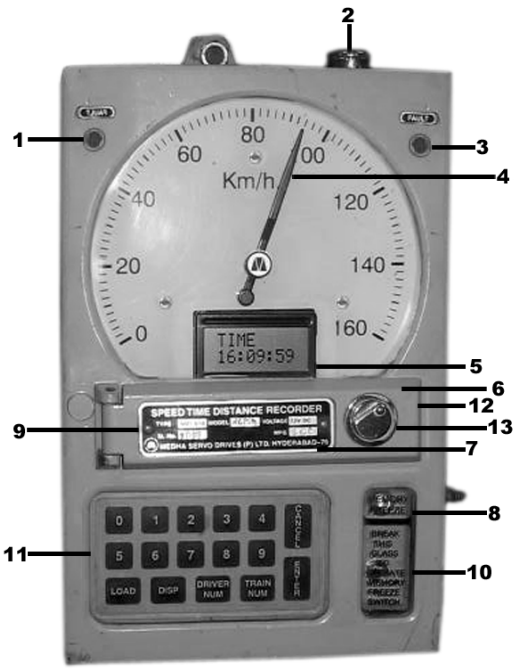
1. Knurled screw
2. Door Lock
3. Light Knob
4. Chart Viewing window
5. Over Speed Indicator
6. Paper End Indicator
7. ODO Meter
8. Buzzer
9. Memory Card Box

Instructions

1. **During over speeding a preset-able 'Over Speed Audio Visual indication provided to alert the driver,**
2. 'PAPER END' indication glows when graph when graph roll is exhausted.
3. Memory capacity 6 Hrs.

SPEED TIME DISTANCE RECORDER CUM INDICATOR

MRT – 918



MRT-918

PARTS:

1. MEMORY INDICATION
2. TOP COVER LOCK
3. FAULT INDICATION
4. SM POINTER
5. 16CH ALFA NUMERIC DISPLAY
6. PS 232 SERIAL PORT
7. SELECT PARAMETERS SWITCH
8. MEMORY FREEZE INDICATION
9. MEMORY CARD
10. MEMORY FREEZE SWITCH
11. KEY BOARD
12. MEM CARD BOARD
13. MEM CARD BOARD LOCK

The fault LEDs:

Two fault LEDs are provided, one for the Memory fault (Green colour) and the other for the system fault (Red colour).

Memory Fault LED (Green colour) :

The Memory LED will blink at a low frequency (approximately 0.5 Hz) once the Memory is 85% full. After 100% Memory is full the LED will be continuously ON.

The LED will blink continuously at a high frequency (approximately 3 Hz) whenever the Memory card is faulty.

System Fault LED (Red colour) :

Whenever the Analog Indication fails and this LED will glow and the Speed (Digital) will be displayed in the LCD display. System failure.

SETTING OF PARAMETERS:

To set these parameters the Door shall be closed and speed shall be zero.

It is possible for the Driver to set the following parameters only.

- Loco Load
- Dial Illumination (10 to 90%)
- Driver No.
- Train No.

TO SET THE LOAD :

- Press the LOAD key on the keyboard.
- Existing Load value is shown on the Display with first digit blinking.
- Enter the new value with the numeric keys 0-9.
- After setting the desired value press ENTER key to accept the new value.

TO SET DIAL ILLUMINATION:

- Using the DISP key to view the parameters, select Dial illumination.
- Existing number is shown on the Display with first digit blinking.
- Enter the new value with the Numeric keys 0-9.
- After setting the desired value press ENTER key to accept the new value.

TO SET DRIVER NUMBER :

- press the DRIVER NUM key on the keyboard.
- Existing number is shown on the Display with first digit blinking.
- Enter the new value with the Numeric keys 0-9.
- After setting the desired value press ENTER key to accept the new value.

TO SET TRAIN NUMBER :

- press the TRAIN NUM key on the key board .
- existing number is shown on the display with first digit blinking
- enter the new value with the numeric keys 0-9.
- After setting the desired value press ENTER key to accept the new value.

MEMORY FREEZE OPERATION :

Memory Freeze facility is provided to allow the loco to be moved after an accident, without overwriting of the data on the latest data stored. There will not be any further recording of the data in the short memory.

The Memory Freeze Switch and the Indication are provided inside a sealed glass cover on the Recorder Cum Indicator unit.

The glass has to be broken to operate the switch. Once the switch is operated the LED will be on.

There will not be any more recording in the short memory as long as the Memory Freeze switch is on.

MICRO CONTROLLER BASED GOVERNOR - BHEL

The micro controller based governor (here after called as MCBG) for diesel electric locomotive consists of three sub-assemblies, namely

1. Actuator/Sensor unit.
2. Controller/Display unit.
3. Crank Rod assembly.



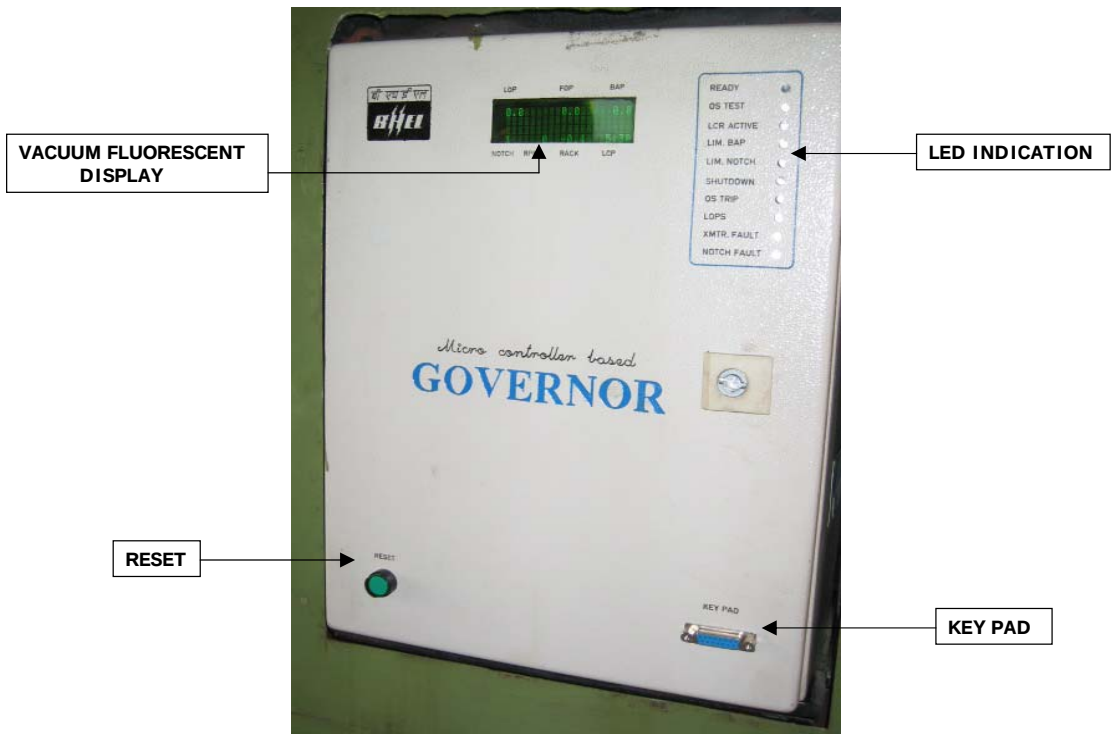
Actuator/Sensor unit:
The Actuator unit consists of the following items.

a) DC Servo motor for driving the fuel control shaft of the diesel engine with inbuilt position sensor for measuring the servo motor output shaft position.
b) Lube oil pressure (LOP) transmitter
c) Boost air pressure(BAP) transmitter
d) Fuel oil pressure (FOP) transmitter.

Location:

Items a to d are housed in an enclosure. The enclosure is to mounted in the engine compartment at the existing location of Woodward/GE governors.

Controller/Display unit:



DISPLAY/CONTROLLER UNIT BHEL (MODIFIED)

This unit consists of electronic circuitry for

a) Processing the notch position selected with THROTTLE HANDLE.
b) Processing engine rpm signal derived from the existing tacho generator mounted against cam shaft gear teeth.
c) Processing the signals from LOP, FOP transmitted, BAP transmitter and servomotor position sensor located in the Actuator/sensor unit.
d) Driving the Servo motor in the Actuator/Sensor unit.
e) Displaying various parameters Viz. Engine rpm, notch, lube oil pressure (LOP), Boost air pressure (BAP) Fuel oil pressure (FOP) Load control potentiometer position (LCP) and Fuel rack position (FRP) etc.
f) Providing output to "E-type Excitation system" for Loading of engine in form of reference voltage (24.4v to 68.8v).
g) Processing the operator commands through a front panel mounted keyboard.
h) Providing display of engine parameters and visual indication of engine status/faults/alarms etc.

The electronic circuitry is housed in an instrument Enclosure, which is designed to prevent the ingress of dust, moisture, oil etc.

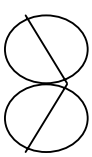
Location of controller/Display unit

The controller/Display unit is mounted on the short hood side wall just below the existing location of lube oil, Fuel oil, Booster air pressure gauges in the Engine driver's cabin.

OTHER FRONT PANEL SWITCHES

Two key switches and one push button are provided in front panel for the below given operation..

POWER Key switch:



Position: MCBG is un-energized.

Position: MCBG is energized. Actuator output moves to zero fuel position.

RESET push button

When a shut down occurs due to LOPS or OST initiated by MCBG, it should be acknowledged by pressing the RESET push button. This resetting is required before re-cranking the engine.

OS TEST Key switch



Position (Run): OST setting of MCBG= 10 RPM less than OST setting of mechanical device.



Position (Test): OST setting of Electronic governor=1210 rpm.

For testing the Actual setting of the mechanical device on the engine the key switch "OS TEST" must be kept in this position.

DOOR LOCK

For locking the front panel of the MCBG

OPERATING INSTRUCTIONS FOR THE LOCOMOTIVE ENGINE DRIVER

Status of front panel indications during engine SHUT DOWN

Before cranking the engine, since the engine rpm is zero the "SPEED LOW' LED will be ON. If the engine had been shut down due to OST mechanism of governor "OS TRIP" LED will be ON. Similarly, if the engine had been shut down due to low lube oil pressure 'LOPS" LED will be ON. If the engine had been shut down due to any reason, the SHUTDOWN LED is also ON along with the above-mentioned LEDs.

Pre-requisites for cranking the engine;

Step 1.

- The "Throttle handle" should be in "IDLE" position.
- Mechanical "over speed" trip mechanism should be in reset condition.
- If "OS TRIP" or "LOPS" LED or "OS TEST" LED is ON, push the reset button momentarily. OS TRIP/LOPS/OS TEST LEDs will become OFF and the 'READY' LED will become ON.
- (Note: The 'SPEED LOW' LED and the 'SHUTDOWN' LEDs also will be ON, since the engine has not been cranked).

Step 2.

Crank the engine normal way. Release the cranking start button in the driver's cab, once the engine has fired. The MCBG will take control of the engine and regulate the rpm at the "IDLE" rpm.

Status of front panel indications during LOPS:

If the engine shut down occurs due to LOPS, the "LOPS" LED, 'SHUTDOWN' LED and the 'SPEED LOW' LED will become ON.

Status of front panel indications during OS TRIP:

If the engine shutdown occurs due to governor over speed trip mechanism, OS TRIP LED, 'SHUT DOWN' LED and 'SPEED LOW' LEDs will become ON.

However, if the engine shuts down due to mechanical OST device, 'SHUT DOWN' LED and SPEED LOW LEDs will be ON.

Frequently asked Questions

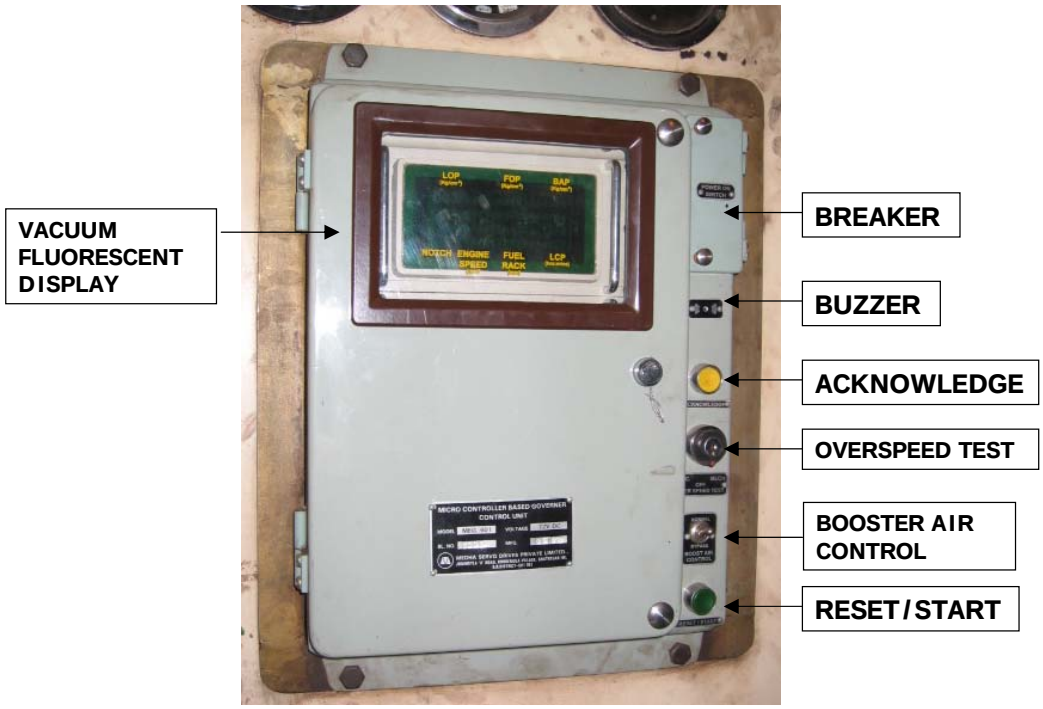
Q. What is full description of MCBG?
A. Micro Controller Based Governor.

Q. What happens, if RPM signal has not come or wire opens?
A. Engine RPM signal comes to MCBG will be zero and engine will shut down.

Q. What happens, if sensors signals not come or wire opens?
A. Display will show transmitters faulty and XMTR FAULTY indication will be ON, and actuator will move to zero rack to shut down loco.

Q. What happens, if Actuator motor signal not come or wire opens?
A. Display will show "Actuator faulty", and actuator will move to zero rack to shut down engine.

Q. Why FOP pressure is measured?
A. Fuel Oil Pressure is measured for display only; it does not have any relation with performance of Governor.



MICRO CONTROLLER BASED GOVERNOR - MEDHA

SYSTEM DESCRIPTION

The Micro Controller based governor (MCBG) consists of following sub assemblies

1. CONTROL UNIT
2. ACTUTATOR UNIT

CONTROL UNIT

The control unit is mounted on the wall on short hood side, just below the existing location of lube oil, fuel oil and booster air [pressure gauges in the driver's cabin, or any other suitable location .

ACTUATOR UNIT

The actuator unity will be mounted on locomotive engine at the present position of wood governor. The actuator unit, houses the fuel rack drive consisting of stepper motor , gear box, clutch and a spring. This unit converts the electrical signals from control unit into mechanical moment of fuel rack. When the clutch is disengaged the spring pulls the fuel rack to "No Fuel" position , so that the engine is shut down. Fuel rack position sensor and pressure sensors are also housed in this unit. The electrical signals from these sensors are transmitted to control unit.

PRESSURE SENSORS

a) Booster air pressure Sensor:
   Working range is 0 to 3 kg/cm2 gauge.

b) Fuel Oil Pressure Sensor :
   Working range is 0 to 5 kg/cm2 gauge

c) Lube oil pressure sensor :
   Working range is 0 to 10 kg/cm2

Display :
20 characters X 4 line alpha numeric vacuum fluorescent display.
Following engine parameters are displayed while engine is running.

a) Notch Position
b) Engine RPM
c) Fuel rack position in mm
d) Boost air pressure in kg/cm2
e) Lube oil pressure in kg/cm2
f) Fuel oil pressure in kg/cm2
g) LCP position in hours: minutes format.

System status messages and fault messages are also displayed as and when required.

SAILENT FEATURES

- Engine RPM is controlled without hunting.
- Effective control for complete combustion of fuel, thus improving fuel efficiency and reducing pollution.
- Load Control interface with Excitation system for constant Horse Power control.
- User settable engine parameters for optimizing performance for different classes of locomotives.
- 16-bit micro controller based design.
- Stepper motor used for high precision position control of fuel rack.
- Digital PID control, Requires no adjustment through out its life, and no potentiometer settings.
- No need of individual tuning for each engine. Once tuned digitally for a given class of locomotives, say WDM2, or WDG2 etc. the same parameters would be entered numerically for all the engines of that class.
- Continuous display of engine status parameters.
- Online fault diagnostics and fault message display.
- Error log with date and time stamp.

- User settable engine horse power, RPM & LOPS levels for each notch.
- User settable Booster Air Pressure Vs Fuel Limit curve.
- Laptop computer used for tuning of parameters. User/friendly menu driven software provided for laptop computer, for modifying any parameter/down loading ERROR LOG.
- Electro magnetic clutch used for automatic shutdown of engine, in case of power failure and any major malfunctioning of the equipment.
- Electronic and Mechanical Over speed trip testing through key lock switch.
- Switch to bypass Boost Air pressure based Fuel Limit Control.
- Functional plug in modules for ease of servicing.
- Wiring minimized for high reliability.
- No need of regular maintenance.

FAIL-SAFE FEATURES

Automatic Shutdown of engine in case of

- Lube oil pressure sensor failure.
- Tacho signal failure.
- Motor Over current.
- Micro Controller, EPROM, or Bus driver's failure.
- Software corruption.
- Power supply failure.
- Engine over speed.
    - Booster air pressure Sensor failure automatically disables air pressure based fuel limiting.
    - Fault Tolerance for fuel rack position sensor failure.
    - Engine runs at notch 1 in case of notch input fault.
    - Runs with default parameters in case of EEPROM failure.

SR. No.	DISPLAYED MESSAGE	INTERPRETATION
1	Notch Fault	If any illegal combination of A, B, C, D solenoid control inputs, is received, this message is displayed.
2	BAP Limit	Whenever Boost Air pressure sensing is active and rack is limited due to available boost air pressure this status message is displayed.
3	HP Limit	Whenever load control action is enforced due to Horse Power Limit set for the Notch, this message is displayed.
4	Rack Poser	This is displayed whenever fuel rack movement is not as desired while engine is running.
5	BAP Ld Control	Whenever load control action is enforced due to booster Air Pressure is Less than the Limit set for the fuel rack position, this message is displayed. This feature can be disabled in user settable parameters.

MICRO PROCESSOR CONTROL SYSTEM -GE

CHAPTER-I

INTRODUCTION

1. Indian Railways is now holding the fleet of Diesel locos with microprocessor controlled excitation system. Such fleet of Diesel locos are now available at KJM/SW Railway and GY/SC Railway.
2. Microprocessor controlled excitation system replaces the conventional electronic type excitation system.
3. These locos are capable of guiding the engine crew on various locomotives operational parameters online through Drivers friendly display system.
4. All the critical parameters of the locomotives while in service are being monitor continuously by the microprocessor and whenever any abnormality is noticed, such parameters are being store in the form of pre determined faults for further investigation to take corrective action by the maintenance shed, apart from alerting the engine crew.
5. Locomotive has the feature of self testing for operation/function of all the electrics of the locomotive system.
6. Interaction with microprocessor is menu based for easy operation by the engine crew as well as by the maintenance staff.
7. Various operating handles of the control stand of the microprocessor based locomotive are similar to that of conventional locomotives (Joy stick type)
8. Position of various equipments like power contactors, relays is similar to the conventional type.
9. During load box testing different parameters can be captured and stored by microprocessor for feature references.

CHAPTER-II

VARIOUS FEATURES

1. Microprocessor replaces the ECP, VRP, TRP, EXCP of the conventional loco.
2. 28 sensors are available at various locations to capture different critical parameters of the locomotive while in service for transmitting it to Microprocessor
3. Automatic sanding during wheel slip, along with power reduction.
4. Controlling of the fan speed according to the temperature of cooling water and lube oil. It automatically reduces the engine power whenever the water/lube oil temperature rises to the maximum limit (at about 95°C)
5. The effectiveness of the dynamic brake is according to the speed of the locomotive, whenever the driver activates it.

6. Provision of extended range dynamic brake system enables the driver even to stop the train. Dynamic brake is effective even in lower speeds.
7. Microprocessor adjusts the input to traction duly taking into consideration of the requirement for the auxiliary loads in order to ensure optimum utilization of the engine power.
8. Microprocessor automatically controls the excitation system whenever it encounters certain critical faults, which are detrimental to the safety functioning of the locomotive in general.

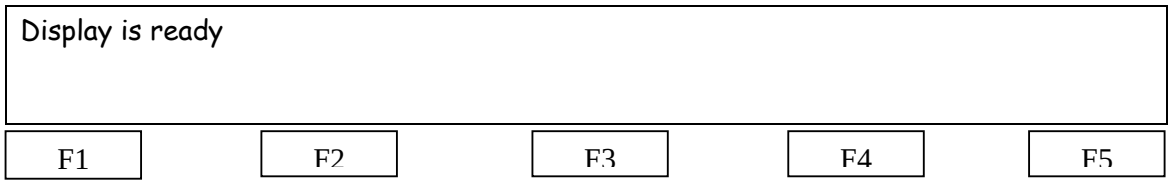
CHAPTER III

PROCEDURE FOR CRANKING THE MICOROPOROCESSOR CONTROLLED LOCOMOTIVES

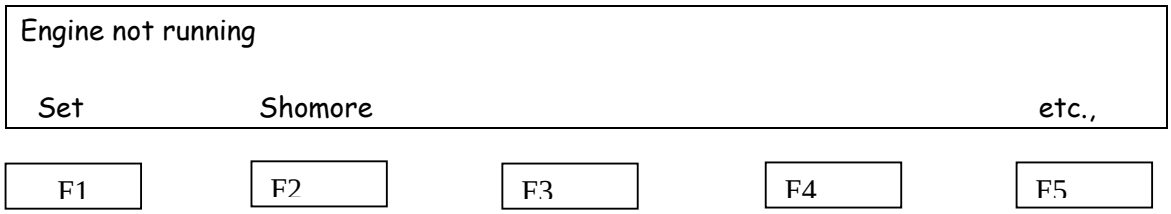
1. inspect all the parts of the locomotive as per the exciting practice and ensure that the loco is ready for cranking.
2. close the Battery Knife switch "BS".
3. Close the 'MUSD' switches on both the control stands to 'RUN' position.
4. Keep the Engine Control Switch to the 'start' position.
5. Close the following breakers:

Sl No.	BREAKER	DESCRIPTION
a.	CCB	Battery charge circuit breaker
B	COB	Main circuit breaker
C	FPB1 & FPB2	Fuel pump breaker
D	ERS	Engine run switch
E	CEB	Crank case exhaust motor breaker
F	EBB	Exhaust blower breaker
G	LCCB	Local control circuit breaker
H	ECB	Exciter field circuit breaker
I	AFCB	Auxiliary generator field circuit breaker
J	ECCB	Eddy current clutch circuit breaker
K	BCCB	Battery charger CCT breaker

6. In DID panel following display appears:



7. After about 60 to 70 seconds following display appears :



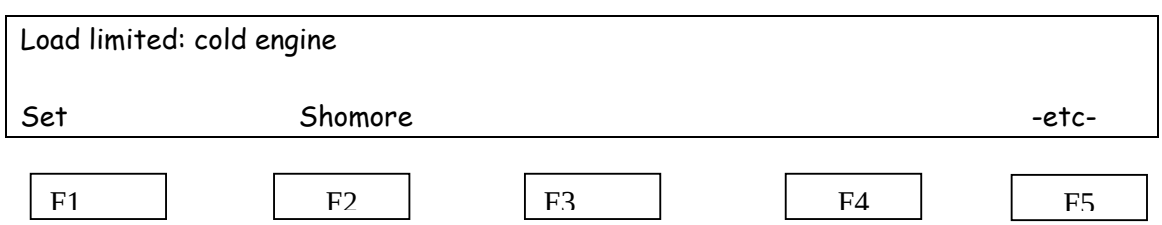
8. Keep the 'ECS' in 'Start' position ... (there are three positions – Start, Isolate and Run.

9. Move the engine start switch (EST) in 'prime' position. Fuel pump motor starts working and fuel oil pressure builds up.

10. Move and hold the engine start switch (EST) in 'start' position till the engine cranks, and then release.

11. During cranking observe that the 'GS+' and 'GS- ' contactors picks up and drops after engine is cranked..

12. Put engine control switch (ECS) to 'run' position and following display appears on DID :



13. After the engine water temperature attains above 60 deg., following display appears:

Ready	I = 20 A	V = 72 V	P = 6.0 Kg/cm2	T = 60° C
Set	Shomore			-etc-
F1	F2	F3	F4	F5

14. The engine speed and load is restricted according to the lube oil temperatures as shown below :

Up to 30°C	--	Idle
30°.C to 32 °C	--	1st Notch
32 °C to 35 °C	--	2nd Notch
35 °C to 49 °C	--	3rd Notch
49 °C to 55 °C	--	4th Notch
55 °C to 60 °C	--	5th Notch

PROCEDURE FOR SHUT DOWN

1. Throttle handle to 'Idle' position.
2. Reverser handle to 'Neutral' position.
3. Switch off GF, MCB, MFPB1 & MFPB2 on both control stands.
4. Move the Engine Control switch to 'Start' position. Press ESP (Engine Stop) push button. Display on DID shows following :

Engine not running				
Set	Shomore			-etc-
F1	F2	F3	F4	F5

5. Switch off all the breakers.
6. Open Battery Knife switch.
7. Remove the Reverser key (handle) from the master controller.

CHAPTER-IV

FAULTS AND FAULT RESET IN MICROPROCESSOR CONTROLLED LOCOMOTIVES

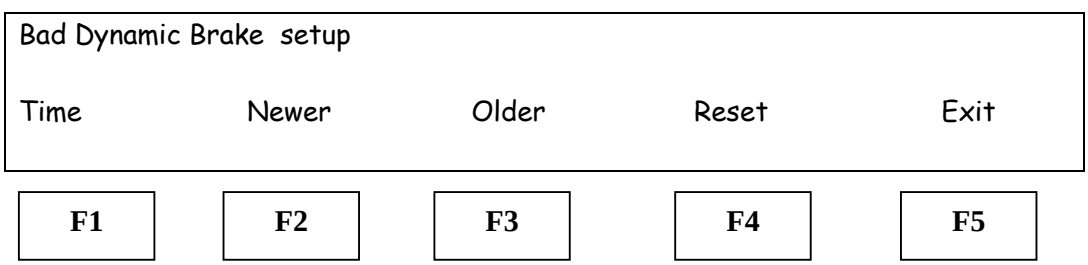
Any faults which occurs in locomotive, the microprocessor stores it as Automatic, LEVEL 1, LEVEL2 or LEVEL3. The faults stored can be viewed on the DID panel. The alarm bell rings depending on the fault.

1. Automatic faults are reset by the microprocessor itself
2. LEVEL1 faults are to be reset on DID panel by the operator pressing "Reset" key.
3. LEVEL 2 faults can be reset after toggling "DAS" switch in control panel and pressing the 'Reset' key.
4. LEVEL 3 faults can't reset.

Microprocessor stores and displays the fault till fault is cleared and resetted. Depending on the severity and duration, some faults changes from 'LEVEL 1' to 'Automatic' and 'LEVEL2' to 'Automatic'.

1. Example- Resetting 'Automatic' fault

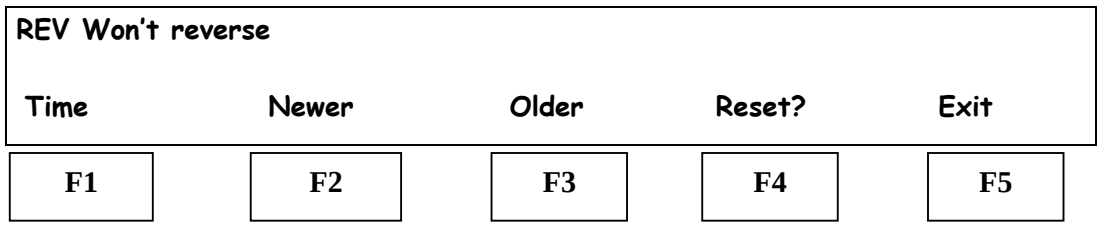
'Automatic reset' faults are reset by the microprocessor itself when the fault no longer exists.



For the above fault, if the selector handle is brought back to neutral, fault is reset automatically.

2. Example – Resetting 'LEVEL 1' fault

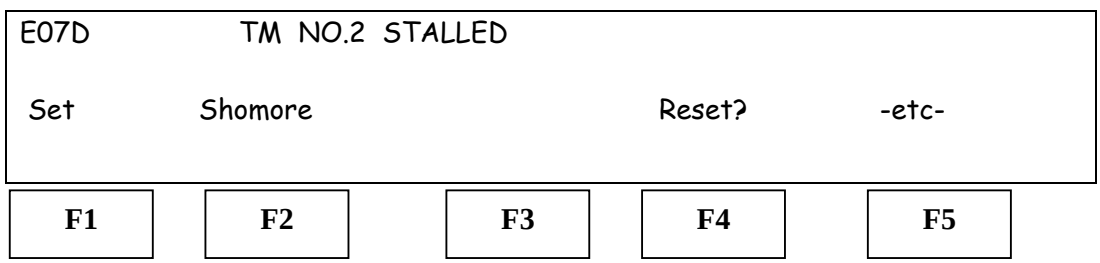
If any fault has occurred, a 'Reset ?' word above 'F4' key appears on DID panel as shown below.



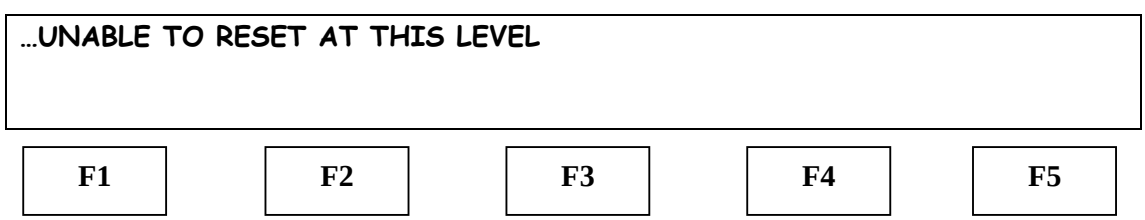
First, check the movement of Reversor and its interlocks, press 'F4' key. The fault resets.

3. Example – Resetting 'LEVEL 2' fault

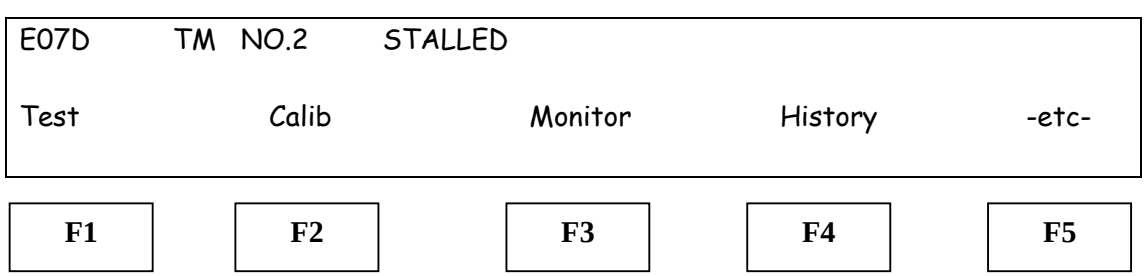
The display appears on DID as:



When the key 'F4' under word 'Reset?' is pressed, following display appears:



Toggle the 'DAS' switch in the control panel. Display appears on DID as:



- This is a LEVEL 2 active fault and indicates Traction Motor No.2 is stalled. Check for Brake Binding/Stalling of TM. No.2
- To Reset the fault press 'F4' key under 'History'. Display appears on DID as:

EO7D	TM NO.2 STALLED			
TIME	NEWER	OLDER	RESET	EXIT
F1	**F2**	**F3**	**F4**	**F5**

Press the 'F4' key under 'Reset'. The fault Resets.

- Press 'F2' key under 'Newer'. The display shows any other faults which are logged. Reset all the faults by above procedure by pressing 'F4' under 'Reset'. When the faults are cleared display appears as:

NO NEWER FAULTS				
TIME		OLDER		EXIT
F1	**F2**	**F3**	**F4**	**F5**

- This indicates, all the faults has been cleared.

4. Example – 'LEVEL 3' fault

The display appears on DID as:

E120	SINGLE PHASED MAIN GENERATOR (AMPS)			
Set	shomore		reset?	-etc-
F1	F2	F3	F4	F5

- This fault can't be reset by pressing 'F4' under 'Reset' and DID display show it as 'LEVEL3' fault.

CHAPTER-V

COMMON FAULTS

For various cautions displayed in DID (Diagnostic Indications Display) following actions are warranted by the LOCO Drivers.
(Note: Always toggle DAS switch before resetting the fault. Then press HISTORY key on DID panel. Then RESET button will appear on DID)

SL.No.	DISPLAY	ACTION
1.	Incorrect Engine speed	Press RESET button (F4 key) on DID & proceed further –(can be ignored)
2.	Bad Dynamic brake (Bell will be ringing)	Press SILENCE button on DID – Bell sound will go & then RESET (keep the REV Handle either in forward or reverse & SELECTOR handle in motoring or braking. This message will be eliminated)
3.	TM.No. 'n' Stall – Ensure that the all wheels are rotating freely.	Press RESET button (F4 key) on DID & proceed further .
4.	Hi Resistance in TM "n".	Press RESET button (F4 key) on DID & Proceed further.
5.	Main Generator over current	Press RESET button (F4 key) on DID & proceed further.
6.	T.M. plug attempt too high speed	Press RESET button (F4 key) on DID & proceed further – (can be ignored)
7.	Generator field current FB – bad	Press RESET button (F4 key) on DID & proceed further

8.	Throttle shutdown commanded (when MUSD is used for shutting down)	Press RESET button (F4 key) on DID (automatic reset)
9.	High current in TM No. 'n'	Press RESET button (F4 key) on DID and check whether all the wheels are rotating freely
10.	MU T/L (6, 17, 21) high	Press RESET button (F4 key) on DID and proceed further by avoiding foot pedal for quick release of formation brakes.

Chapter VI

SENSORS USED IN MICROPROCESSOR CONTROLLED LOCOMOTIVE

Sl No.	Sensor description	Location	Purpose
1.	MR1 sensor.(Main Reservoir pressure Sensor)	Nose Compt.	This sensor senses the main compressor reservoir pressure and give a feedback to Microprocessor. This is used for controlling the loading/unloading of compressor and hence maintaining MR pressure between 8 to 10 kg/sq.cm
2.	LOP sensor. (Lube oil pressure sensor)	Nose compt.	This sensor measures the Engine lube oil pressure and gives feedback to the Microprocessor. The Microprocessor shuts down the engine & gives indication if the Lube oil pressure falls below specified limit.
3.	FOP sensor. Fuel oil pressure sensor)	Nose Compartment	This sensor measures the fuel pressure for diesel engine. Microprocessor prohibits cranking if fuel pressure is below 2.5 kg/sq.cm.
4.	IBPS. (Independent Brake pressure switch)	Nose compartment	This is a switch that gives feedback to the Microprocessor whenever independent brakes are applied.
5.	BPT. (Barometric pressure Sensor)	Control panel	This measures the barometric pressure to determine the altitude and based on this input and ambient temperature, microprocessor will de-rate the engine.

6.	AT. (Ambient temperature Sensor)	Control panel	This measures the ambient air temperature and this along with BPT is used to de-rate the engine due to ambient condition.
7.	EWT sensor (Engine water Temperature sensor)	Water pipeline in Expressor room	This monitors the Engine water temperature. Based on the water temperature, microprocessor initiates appropriate corrective action to keep engine water temperature under control, Such as, running of radiator fan, removing traction power and running engine at higher speed.
8.	LOT sensor. (Lube oil Temperature Sensor)	Lube oil pipeline in Expressor room	This monitors the engine lube oil temperature for protection of diesel engine
9.	DSS (Diesel engine speed sensor)	On Cam gear cover	This monitors the Diesel engine speed and gives feedback to the microprocessor for appropriate functioning
10.	TM Speed sensors-SS1 to SS6 (Six Nos.)	Traction Motors	Six speed sensors are present for measuring the individual TM speed and gives feedback to the microprocessor. These are used to detect the wheel slip/slide and calculate the loco speed
11.	Position sensors for – a) Cranking contactors. b) Reverser c) Braking contactor (BKT) d) GF contactor e) Parallel contactors-6nos f) Series contactors-3nos	On respective contactors	These sensors are interlocks which provide feedback to the microprocessor on status of contactors i.e., whether they are open or close. For BKT it indicates motoring or braking.

CHAPTER-VII

COMMON PROBLEMS

SL.No.	PROBLEM	***ACTION***
1.	Throttle not responding. Load meter dropped to zero	a) Check for PLR (DMR) de-energized b) Ensure BP (5kg) and Vacuum min. 55cms c) Release and apply A-9 d) If not succeeded switch on DMR energizer
2.	**Loco shutdown** **un expectedly**	a) Release throttle for 8th notch to idle check for OSTA tripping b) Ensure LLOB tripping in Wood Ward Governor.

RAKSHA KAVACH
(A NET WORK OF ANTI COLLISION DEVICE)

The commercial proto types of ACD system have been tested over the last 4 Yrs. KONKAN Rly has developed this totally indigenous and economic system first time in the world, which has been technically proven during the joint field trails with RDSO.

ANTI-COLLISION DEVICE (ACD): It is self-acting microprocessor based data communication equipment designed and developed by KONKAN Rly. When installed on Loco Motives (Along with the auto braking units), Guard vans/SLRs, station and level crossing gates (Both manned as well as unmanned), the resultant network of ACD system prevents high-speed collision in mid sections, station area and at level crossing gates, there by saving lives of passengers and road users.

While **entering the station area** if Loco ACD detects the presence of a Train standing or moving away on the main line, it automatically regulates its Train speed to what is maximum permitted over turnouts, there by reducing possibility of high-speed collision. Further if, Loco ACD after entering in station area detects presence of another approaching train on the same track both Loco ACDs automatically apply brakes to stop their respective trains.

While **traveling in the mid sections,** Loco ACDs remains in "lookout" for trains present in the **radius of 3 KMs** to handle following potentially dangerous "collision – like" situations:

- In case, Loco ACD detects that **any other train has stopped on adjacent track** may be due to derailment, Loco failure, cattle run over, alarm chain pulling etc., it will automatically regulate the speed of its train till such time it crosses it and will also warn the driver of the same. If the driver of the stopped train presses '**CANCEL**' button after ensuring that there is no danger to movement of trains on adjacent track, the speeds of other trains will not be regulated. However, if he detects that there is an infringement to the adjacent track and presses **SOS** (**S**ave **o**ur **s**oul) button, the other approaching trains will come to a stop, thereby reducing the possibility either **REAR – END** or **SIDE** Collisions.

- In case, a train detects **another train approaching it on the same track**, the Loco ACDs of both the trains apply brakes to bring the respective trains to a stop, thereby reducing possibility of "**HEAD-ON"** collision.

- In case of train detects **another train moving ahead of it on the same track** its Loco ACD automatically applies the brakes to regulate the train speed, till such time the separation distance between the two starts 'INCREASING' again, there by reducing possibility of **'REAR – END'** collision.

- In case, of a train, approaching a **level crossing gate detects it in opened condition**, its Loco ACD regulates the speed of its train and warn the driver for taking the appropriate action, there by reducing the possibility of **collision of a train with 'ROAD VEHICLES' crossing the LC gate.**

Drivers of the train there by get '**DOOR – DRISHTI'** (a 3kms range detection system in all whether conditions, which a human eye is incapable of) through their Loco ACDs to detect the presence of trains in their vicinity.

By acting independently, the Loco ACDs also acts like '**SAATHI'** companion for the drivers. Further, incase a '**COLLISION-LIKE'** situation is perceived, the drivers get **empowerment** to **stop other approaching trains** by sending '**DISTRESS**' messages through pressing of twin '**SOS'** buttons, provided on their ACD consoles.

The **guard ACD** keeps monitoring the transmission of its LOCO ACD and acts as a stand-by protection to train if Loco ACD stops radiating. In the event of '**TRAIN PARTING'** or '**ROLLING BACK'**, in the mid section (Detected first by guard ACD) Both Loco and Guard ACDs of the train shall radiate this information to prevent **'REAR-END'** and / or '**SIDE** collisions' of their train that might have derailed and infringing the adjacent track.

This **'RAKSHA KAVACH'** also **empowers** its other users to send '**SOS**' to Loco ACDs for stoppage of trains, whenever a **'COLLISION-LIKE** situation is perceived by them as under.

- Guard can send manual 'SOS' through his guard ACD by pressing of twin 'SOS' buttons when he observes dragging of derailed coaches / wagons close to his SLR/BRAKE van or notices a fire in the running train.

- STATION MASTER can send manual 'SOS' through his station ACD by pressing of twin 'SOS' buttons when he notices any thing unusual like hot axle/flat tire / fire etc. in a train, while performing train passing duties.

BASIC FEATURES.

PERFORMANCE SPECIFICATIONS

- 4000 THP Locomotive
- Higher Tractive & Braking effort capability,
- 12 % improvement in fuel efficiency over earlier.

RELIABILITY & SERVICEABILITY

- 90 – day maintenance intervals,
- AC motors doubles traction motor life,
- No running maintenance required, No brushes, Commutator, or rotor insulation No flashover/ground relays,
- Truck inverter control- High level of reliability with fewer parts,
- 1 million mile overhaul with HTSC truck,
- 6-year engine overhaul period.

PERFORMANCE IMPACT

- The GT46 MAC provides unit reduction, fuel savings and additional revenue tonnage capability
- Operation of fewer units results in significant maintenance and operating savings

ENGINE

- 16 – 710G 3B
- High efficiency turbocharger
- Unit fuel injection

AC TRACTION TECHNOLOGY

- Simple, robust motor design
- Higher efficiency / lower temperatures
- Doubles motor overhaul interval
- Utilizes truck – controlled AC traction inverters for higher inherent reliability

SPECIFICATIONS

- Total weight on rails, 129 Tonnes
- Height – top of rail to top of cooling fan 13'6" (4.12m)
- Overall length; 69ft 9in. (21.3m)
- Fuel capacity – (6000ltrs)

- Increased lube oil capacity (1457ltrs)
- Cooling water capacity (1154ltrs)

HTSC BOGIE

- No wearing surfaces extends bogie overhaul intervals to one million miles (1.6million kilometers)
- Dual high adhesion and high speed
- Available gear ratios for heavy haul and passenger operation

EM2000 ADVANCED COMPUTER

- Improved reliability & performance
- Information can be downloaded to a lap top computer
- Flexible and expandable to accommodate future system enhancements
- Complete self – diagnostics
- Archived unit history data

CAB FEATURES

- Dual desk type control console
- Air operated windshield wipers
- Multi re-settable vigilance controls

AIR SYSTEM

- Electronic Air Brake System available
- Direct drive air compressor

IMPORTANT OILS USED FOR (WDG4/WDP4) LOCOMOTIVES.

1.	Main Engine Oil	: RR 520 MG,
2.	Compressor Oil	: Servo Press 100,
3.	Gear case Oil	: Mobile SHC634,
4.	Governor Oil	: Same as Main Engine Oil,
5.	Wheel Flange Lubricator	: Servo WFL Grease,
6.	Coolant Compound (Chemical for Water Treatment)	: Nalco 2100 (Pink Colored Borate Nitrate)

PARAMETERS OF WDG4/WDP4.

1. LOCOMOTIVE

Model	:GT46 MAC (WDG4) GT46 PAC (WDP4)
Horse power	:4000 HP.
Input to traction	: 3726HP (2780 KW).
Maximum starting effort	:540 KN/270 KN. (WDG4/WDP4)
Continuous Limit	:400 KN/200 KN. (WDG4/WDP4)
Max. Dynamic Braking effort	:270 KN (from 40 KMPH to Zero KMPH for WDG4) 160 KN (from 68 KMPH to Zero KMPH for WDP4)

2. DIESEL ENGINE

Engine Model	:710 G3B.
No. of cylinders	:16
Engine type	:Turbo charged Two stroke Diesel Engine.
Bore/stroke	:230.1 mm/279.4 mm(9 1/16 & 11 inches.)
Compression Ratio	:16:1
Fuel Injection system	: Mechanical Unit Injectors.
Cylinder arrangement	:45^0 , 'V' type.
Crank shaft rotation	:Counter Clockwise (facing Fly Wheel end)
8th notch Engine RPM	:904.
Idle Engine RPM	:269.
Low Idle RPM	:200.

3. TURBO CHARGER

Model	:EMD 'G' series.
Drive	: Up to 5th notch through crank shaft gear and exhaust gas, from 6th notch onwards only on exhaust gases.
Cooling	: It is not a Water cooled unit, it is cooled by Lube oil.
Gear ratio	: 18:1 (Engine gear 18 & Turbo gear 1)

4. MAIN GENERATOR

Model Number	:	TA 17 - CA 6B
Traction Alternator	:	(includes Rectifier) TA 17-6.
Companion Alternator	:	CA 6B.
Tr. Alternator rectifier out put	:	2600V DC.
Max. continuous current	:	1250 Amps.
Companion alternator output	:	230V AC.

5. EXCITATION SYSTEM : There is no Separate Exciter Generator. Here Companion Alternator will excite Main Generator field through Silicon Controlled Rectifier (SCR)

Type	:	3 Ph. solid state SCR bridge.
Rating	:	125 A DC continuous.

6. ENGINE GOVERNOR : Wood Word PGR with internal Load Regulator.

7. AUXILIARY GENERATOR

Model No	:	5A - 8147
Type	:	3 phase alternator with brush less Excitation and rectified output.
Maximum Power Output	:	24HP (18KW).
Normal AC Voltage	:	55 Volts AC
Rectified Output	:	74 Volts DC.

8. TRACTION MOTORS

Model No	: SIEMENS ITB-2622
Quantity	: WDG4: 6 Nos.(3 per truck in parallel) WDP4: 4 Nos.(2 per truck in parallel)
Type	: 3 Phase AC induction motor.
Rating (nominal)	: 670HP or 500 KW at 3220 RPM.
Constant current	: 202 Amps AC
Constant Voltage	: 2600 V DC .
Gear ratio	: 90:17 / 77:17, WDG4/WDP4(Bull Gear: Pinion).

9. TRACTION INVERTERS(TRACTION CONTROL CONVERTERS TCC1 AND TCC2)

Type	:Voltage source inverter with Gate Turn-off Thyristors. (GTO)
Quantity	:02 (one per truck)

10. TRUCKS

Model	:HTSC.
Wheel Arrangement	:CO-CO.
Maximum Axle Load	:21.42 T/19.5 Tonnes. (WDG4/WDP4)
Wheel Dia	:43 inches Max & 40 inches Min.
Centre Pivot	:1 per truck to transmit pulling and Braking forces.
Load pads	:4 sandwiched Rubber pads per truck Shares the load of the loco. (100%)
Brake rigging	:4 Brake cylinders per truck with composite brake blocks.(06 per truck)

11. COMPRESSED AIR SYSTEM

Air compressor type	:2 stage, 3 cylinders, water cooled by engine cooling water system.
Displacement	:254 Cu.Ft. per minute. at 900 RPM.
Drive	:From engine
Lube oil sump capacity	:9.98 liters.

12. LOCOMOTIVE STORAGE BATTERIES

WDG4

Model	: Excide lead acid battery.
Quantity	: 8 nos. connected in series.
No.of cells	: 4 (per battery).
Cell Voltage	: 2.2 Volts DC
Battery Voltage	: 8.8 Volts DC
Potential across all Batteries	:70 Volts DC

WDP4

Model	: Ni-Cad/Saft-Nife SRX1500P
Quantity	: 10 nos. connected in series.
No.of cells	: 5 (per battery).
Cell Voltage	: 1.45 Volts DC
Battery Voltage	: 7.25 Volts DC
Potential across all Batteries	:72.5 Volts DC

13. AIR BRAKE SYSTEM

Model	: KNORR Computer Controlled Brake System (CCB)
TYPE	: Electro Pneumatic

14. CAPACITIES

Engine Lube Oil	: 1457 Ltrs,
Engine Cooling Water	: 1154 Ltrs,
Fuel Tank	: 6000 Ltrs
Sand Box	: 12 Cubic feet. for 8 boxes

15. MAJOR LOCOMOTIVE DIMENTIONS

Height	: 4.16 M
Width	: 3.07 M
Length over pulling face	: 21.24 M
Length over CBC beams	: 19.97 M
Weight	:129 Tonnes

16. LOCOMOTIVE SPEEDS

Maximum Speed	: 100/160 Kmph. (WDG4/WDP4)

ENGINE STARTING IN WDG4 OR WDP4

1. Inspection to be done on under gear.
2. Inspection to be done on engine & engine doors to be in close.
3. Fuel oil level to be checked in fuel tank through glow rod gauge.
4. Lube oil level to be checked in lube oil sump through dip stick gauge.
5. Compressor oil level to be checked in compressor through unscrew(dip) stick gauge.
6. Governor oil level to be checked in wood ward governor through sight glass.
7. Cooling water level to be checked in expansion tank through glow rod gauge in engine dead gauge.
8. Secure the locomotive with hand brake which is available on loco right side near engine starting room (Engine Accessories Room).
9. Check for the over speed mechanism must be in reset position.
10. Check the governor low pressure trip plunger must be in reset (LLOB).
11. Check that low water pressure button in reset. (If in trip, press for 5 seconds for reset)
12. Check the crank case button in reset (if in trip, press for 5 seconds during cranking)
13. Check that the LWS 3-way cut out cock in open condition.
14. Close the Battery knife switch in battery switch room. Before closing ensure that the starting fuse must be in fuse carrier and all the breakers must be in 'OFF'.
15. Keep MUSD Switch in run condition (press green button in driver desk No.2)
16. Keep engine run switch and GF switch in 'OFF' (in driver desk no.2)
17. Keep control/fuel switch in on (in driver desk no.2)
18. Close all back labeled breakers on control breaker panel.
19. Close at last yellow labeled breakers on control breakers panel.
20. GRCO toggle switch to be keep in on and sealed (available in control breaker panel) Keep isolation switch in start (available on ECP)
21. Keep Engine starting switch in fuel priming with left hand and observe that first sight glass (towards engine side) must fill with fuel oil, if it is not filling do not go for cranking.
22. Keep Engine starting switch in engine starting with left hand.
23. At the same time press the Governor lay shaft to 1.72 gauge with right hand (to get quick firing by boosting the governor).
24. Engine will crank and fire, release both hands.
25. Engine starting motors will dis-connect electrically and mechanically from the engine.
26. In case of WDP4, Engine starting switch is provided on engine control panel. After keeping in fuel priming and ask assistant for fuel return sight glass fuel filling (first sight glass)

27. Then keep engine starting switch in engine starting. Automatically Governor booster pump also getting energized, for engine firing (To get quick firing by boosting of governor)
28. Before engine cranking close event recorder, Air drier and Governor Booster Pump Breakers available on White Labeled Breakers panel.

COMPUTER FUNCTIONS

1. Excitation control Main Generator output in motoring and Dynamic Brake by varying the timing of the getting pulses to the SCR assembly. These pulse control the strength of the main generator field.

2. Logic monitor the position of control devices in the cab (throttle position and switch position), and monitor and control ON/OFF devices on the locomotive (e.g. Governor speed solenoids, contactors, relays and magnet valves) Display accept inputs from the display panel, record data in achieve memory, display information on the display screen and initiate diagnostic functions through the display panel.

POWER DISTRIBUTION SYSTEM

PARTS DRIVEN BY ENGINE.

When the Battery supplies current to starting motors, Engine crankshaft starts rotating. At the free end Compressor starts working. At the power take off end Main Generator starts rotating including Companion Alternator. On the other hand Auxiliary Generator, Main Generator Blower and Traction Motor Blower,3 lube oil pumps, 2 water pumps and Turbo up to 5th notch are driven by Main Crank shaft Gear.

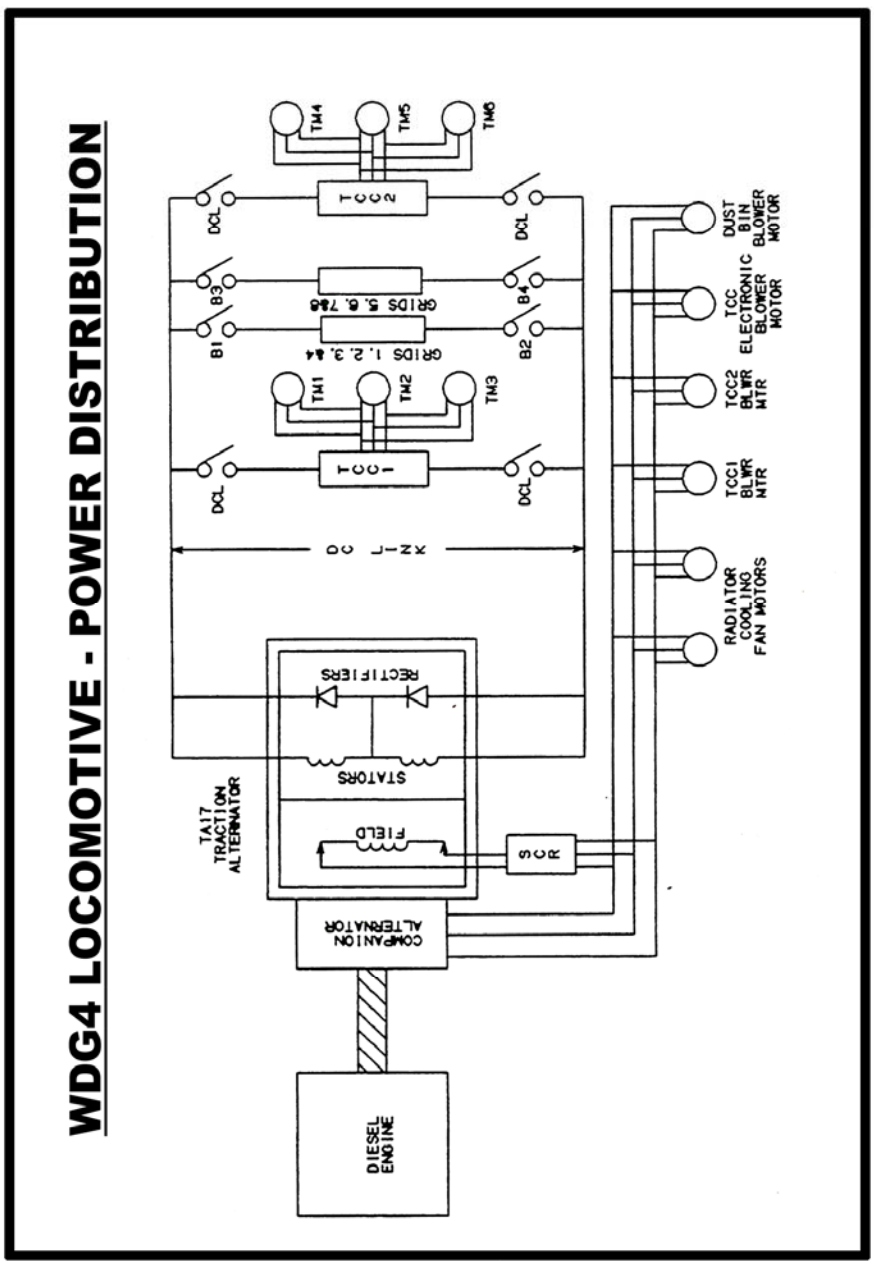
1. AUXILIARY GENERATOR : The auxiliary generator is Self Excited Generator driven by engine gear at three times of Engine speed. The output of aux. Gen. is converted to 74V DC in a rectifier & output from the rectifier is utilized for the following:

1. To excite the companion alternator field.
2. Control systems.
3. Battery charging.
4. Fuel Pump Motor.
5. Turbocharger soak-back pump.
6. Lighting and Misc. equipment.

2. COMPANION ALTERNATOR: The companion alternator is coupled to the traction alternator and it is within the main generator assembly. It produces 3 phase AC supply which is going to fed for:

1. To drive the two Radiator cooling fan motors No.1 & 2.
2. To drive the TCC Electronic blower motor.
3. To drive the traction inverter blowers (TCC1 & TCC2).
4. To drive the Dust bin blower motor.
5. Through Silicon controlled Rectifier Bridge, Traction Alternator field is excited.

3. MAIN GENERATOR OR TRACTION ALTERNATOR: The main generator rotates at engine speed and generating 3 phase AC power. The AC power is then converted to DC by rectifiers which are powered within the generator assembly and the DC output is applied to DC link. The DC link Switchgear apply DC voltage to traction inverter circuits (TCC1 & TCC2). The traction inverters convert the DC link voltage to 3 phase AC power for the traction motors. Both inverters are in turn controlled by EM200 main computer. TCC1 and TCC 2 controls the traction motors by varying the voltage and frequency to get the proper torque and speed. DC link voltage varies with throttle position from 600V DC to 2600V DC at 8th notch.


WDG4 LOCOMOTIVE - POWER DISTRIBUTION
DIESEL ENGINE
COMPANION ALTERNATOR
TA17 TRACTION ALTERNATOR
FIELD
STATORS
RECTIFIERS
SCR
D C L-NX
DCL
B1
B2
B3
B4
GRIDS 1, 2, 3, &4
GRIDS 5, 6, 7&8
TCC 1
TCC 2
TM1
TM2
TM3
TM4
TM5
TM6
RADIATOR COOLING FAN MOTORS
TCC1 BLWR MTR
TCC2 BLWR MTR
TCC ELECTRONIC BLOWER MOTOR
DUST BIN BLOWER MOTOR

TCC1 will control TM 1,2 &3 (WDG4) TM 1 & 2 (WDP4)
TCC2 will control TM 4,5 & 6 (WDG4) TM 3 & 4 (WDP4)

During dynamic braking the energy of the moving train is transmitted into rotating energy in the Traction Motors. 3 phase AC supply generated by all TMs will be fed back to traction inverters TCC1 and TCC2 which converts to DC and supplied to Dynamic braking Grids through Braking contactors B1, B2, B3 & B4., which dissipate the electrical power in the form of heat.

TCC1 will supply DC power to grid numbers 1,2,3,4 & BKBL motor 1 through DCL, B1 & B2 Contactors.

TCC2 will supply DC power to grid numbers 5,6,7,8 & BKBL motor 2 through DCL, B3 & B4 Contactors.

DIFFERENCES BETWEEN WDG 4 & WDP 4

SL NO.	DESCRIPTION	WDG 4	WDP 4
01	Model	GT 46 MAC	GT 46 PAC
02	Service	Goods	Passenger
03	Speed	100 Kmph	160 Kmph
04	Weight	126 Tonnes	118.5 Tonnes
05	No. of axles	6	6
06	No. of TMs	6(each bogie 3)	4 (each bogie 2)
07	Under TCC 1	1,2 & 3 Axle TMs	1&2 Axle TMs
08	Under TCC 2	4,5&6 Axle TMs	5&6 Axle TMs
09	TM pinion to bull gear ratio	17 : 90	17 :77
10	Batteries	Lead acid batteries	Nickel cadmium
11	No. of batteries	8	10
12	No. of cells	32	50
13	Cell voltage	2.2 Volts	1.45 Volts
14	Total Voltage	70 Volts	72.5 Volts
15	Blended brake	Not available	Available
16	Location	No	On engine control panel
17	Engine starting switch	Located in engine starting room(engine accessories room)	Located in the engine control panel
18	For quick engine firing	GOV Lay shaft manually operated	Gov. booster pump starts automatically
19	Battery box	In between front bogie and fuel tank	Located between fuel tank and rear bogie
20	Radar system	Located between front bogie and fuel tank, back of battery room	Located between fuel tank and rear bogie, back of battery room

SL NO.	DESCRIPTION	WDG 4	WDP 4
21	Speedometer range	0 to 120 Kmph	0 to 180 Kmph
22	Cab light switch	Near cab light	In control stand side switch panel
23	Low water level switch	Not provided	Provided in the engine water system
24	Temperature gauge	Not provided	Provided in the inlet line to water pump
25	Colour code	No	Blue (Cold), Green (Normal) & Red (Hot)
26	Traction motor cooling	With door controlling by notch position	No door direct air
27	TM HP	630 HP/670 HP	940 HP / 1000 HP
28	Indication panel	TE limit in No. 1 indication	Blended brake cut out in No. 1 indication
29	Tractive effort range in meter	0 to 550 Kilo newtons	0 to 300 Kilo newtons
30	Braking effort range I meter	0 to 300	0 to 200
31	TE limit indication	In indication panel	In meter with LED (Yellow) indication

OPERATING

DIESEL ELECTRIC LOCOMOTIVE

Locomotive is divided into six compartments, and these compartments are hold by means of chassis on two trucks. So both the trucks will hold the super structure of the locomotive as well as does the transmission of power for loco movement. Locomotive towards nose compartment is called short hood side of the locomotive and towards radiator compartment is called long hood side of the locomotive.

The following are the compartments and the items provided in each compartment are given below.

1. Nose compartment, 2. Driver's cab 3. Generator room 4. Engine room 5. Expressor room 6.Radiator room

Nose compartment parts

1. Dynamic braking blower motor (BKBL)
2. Dynamic braking grid resistances
3. A1 differential pilot valve with reservoir
4. VAIB control valve
5. Non-return valve
6. VAI release valve
7. N1 reducing valve
8. Control air pressure gauge
9. Control air reservoir
10. Drain COC for control air reservoir
11. Banking COC
12. COC for A1 differential pilot air valve
13. COC for N1 reducing valve
14. COC for 28 VB control valve
15. Horn COC
16. Windshield wiper motor COC
17. Battery knife switch (bs)
18. Short hood sand boxes

Driver's cab parts

1. Short hood control stand
2. Electrical control stand
3. Brake control stand
4. Long hood control stand
5. Electrical control stand
6. Brake control stand
7. Driver seat
8. D1 emergency brake valve
9. Speedo meter (recorder cum indicator)
10. Speedo meter (indicator)
11. 3/4 " brake pipe COC
12. Hand brake unit
13. Look out (wind shield) glasses
14. Oil pressure switch (ops1 & ops2) [in GE gov. locos only]

Generator room

1. Main generator or Alternator
2. Auxiliary generator
3. Exciter generator
4. FTTM blower.

Engine room parts

1. Engine crank shaft
2. Engine base/lube oil sump/ crank case
3. Engine block/ cylinder block
4. Cylinder head
5. Engine governor (GE/WW)
6. Crank case exhauster motor-blower (CCEM)
7. Turbo super charger (TSC)
8. Exhaust chimney
9. TSC support cum after cooler housing
10. Lube oil pump
11. Water pump
12. FIP cover
13. FIP support
14. Fuel injection pump (FIP)
15. Cam gear with cover (right side)
16. Tacho generator
17. C.C inspection door (sump door)
18. C.C inspection door cum explosion door (spring loaded)
19. Engine bed bolts
20. .Exhaust manifold
21. Water return pipe (R&L)
22. Water riser pipe
23. Fuel trap
24. Fuel oil secondary filter
25. Fuel oil primary filter
26. Fuel oil relief valve
27. Lube oil relief valve | nearer to expressor
28. Lube oil regulating valve
29. Lube oil strainer
30. Fuel oil regulating valve
31. Lube oil dip stick gauge
32. Water jumper
33. Fast coupling unit
34. Over speed trip assembly (OSTA)

Expressor room parts

1. Spy glass for air maze filters (4 nos.)
2. Air maze oil bath filters
3. Low water switch (LWS)
4. COC for LWS
5. Water temperature column pipe (with TS1, TS2, ETS & water temp. gauge)
6. Water system drain COC
7. Flexible coupling unit
8. Air compressor governor
9. COC for AC governor
10. Air filter bowl
11 Fuel pump motor with FBP & GP (GE gov.)
12. Horizontal shaft

Radiator room parts

1. Horizontal shaft
2. Rear truck traction motor blower (RTTM blower)
3. RTTM blower base
4. Drive pulley on horizontal shaft
5. RTTM blower driven pulley
6. 'V' belts (6 nos.)
7. Lube oil cooler
8. Loco left side radiators
9. Loco right side radiators
10. ECC guard
11. Eddy current clutch (ECC) outer drum
12. ECC inner drum
13. ECC clutch coil
14. Slip rings for ECC
15. ECC brush gear
16. Right angle gear box
17. Universal coupling
18. Radiator fan bearing housing
19. Radiator fan
20. Lube oil filter drum
21. Main water expansion tank (no.1 tank)
22. Auxiliary water expansion tank (no.2 tank)
23. Equalising pipes for expansion tanks
24. Water glo-rod gauge
25. Pressure cap assembly
26. Over flow pipe
27. Radiator fan grill
28. Radiator room door
29. Sand boxes for long hood sanders operation

PREPERATION OF LOCOMOTIVE

Driver's Cab: There are two control stands in the Driver's Cab, they are:

1. Short Hood control stand and
2. Long Hood control stand.

In each control stand, the following operating handles are provided.

1. Throttle handle
2. Selector handle
3. There is only one reverser handle; A-9 handle & SA-9 handle which should be fixed to operating control stand on boarding the loco.

Throttle:-

This handle has got an IDLE position & 8 running notches. When opened to running notches, gradual rise in engine speed is obtained. The throttle should be moved notch by notch with a time gap of 5 to 7 seconds. This handle cannot be moved from zero when selector handle is at OFF position and also when the reverser handle is removed from the control stand. Under no circumstances throttle handle should be left in-between two notches.

Selector Handle:-

This handle has got three positions:

1) off 2) 1, 2, 3 &4 Motoring positions and 3) Big D & 15 small Ds knowing as dynamic braking range.

OFF Position:-

In this position, the throttle handle is locked at zero mechanically.

1, 2, 3 &4 Motoring Ranges:-

In motoring No.1 position, the reversor handle can be moved to forward or reverse position. In 2,3 &4 motoring positions of the selector, the reversor get mechanically locked in forward or reverse position.

Whenever frequent change in reversor handle is needed, selector can be kept in 1(i.e. during dynamic operation). When the train is worked in one direction, the selector must be kept on motoring No.4 so that the reversor is locked in 4 particular positions.

D & 15 Small Ds:-

When the selector is moved to 'D'(Big D), the application of dynamic brake stands on RUN moving the selector handle from Big D to Small Ds the effect of the dynamic braking is increased. This handle can be moved to braking only when throttle is at zero and reverser in either on forward or reverse.

Reverser Handle:-

This handle has got three positions.

1. Neutral
2. Forward
3. Reverse

This handle meant for changing the direction of the loco. This handle can be removed from the control stand only in neutral position. It should be inserted only when necessary or otherwise, it must be under the safe custody of the driver.

BRAKES:

The following are the brakes provided in the cab.

1. A9 Automatic brake: With the application of A9 brake valve, formation and conjunctional brakes will come.
2. SA9 independent brake: With the application of SA9 brake valve, Loco brakes only will come.
3. Hand brake: During securing the loco, by application of the Hand brake, one brake cylinder will comes in to action and applies three brake blocks.
4. Dynamic brake: It is an electrical brake. By application of DB, traction motors will work as generator and train speed will be controlled.

GAUGES IN THE CAB

LUBE OIL PRESSURE GAUGE:-

This gauge is provided on the short hood panel of the cab and indicated the lube oil pressure in the system. It will be indicating the normal pressure of 2.5 Kg/Cm^2 in lower notches and 7.5 Kg/Cm^2 higher notches.

FUEL OIL PRESSURE GAUGE

This gauge also is provided on the short hood panel of the cab and indicates the fuel oil pressure in the system. It will be indicating normally 3.8 – 4.2 Kg/Cm^2

BOOSTER PRESSURE GAUGE:-

This gauge is also provided on the short hood panel of the cab and indicates the air pressure inside the air manifold of the air intake system. It will indicate maximum between 1.6 Kg/Cm^2 to 2.4 Kg/Cm^2 on 8th notch on load according to TSC.

ENGINE WATER TEMPERATURE GAUGE:-

This gauge is provided inside the engine room on any one of the water return headers. On some locos, it is inside the expressor room on the water return headers. It indicates the coolant water temperature of the engine.

AIR & VACUUM GAUGES ON CONTROL STAND:

There are four air and vacuum gauges provided on the control stand of the short hood and three on the long hood control stand.

NO.1 Gauge: This gauge has two pointers one indicating the brake pipe pressure and the other indicating the brake cylinder pressure.

No.2 Gauge: This gauge indicates the main reservoir pressure the cutting-in of the compressor governor at 8 kgs/cm^2 and cutting-out 10 kgs/cm^2 can be noticed in this gauge.

NO.3 Gauge: This gauge indicates the vacuum train pipe pressure and vacuum reservoir pressure. There will be a difference of about 1 to 12 cms between them normally.

No.4 Gauge: This gauge is provided on the short hood control stand and indicates the HS4 brake pipe control air pressure (24 psi or $1.7kg/cm^2$). It is a reference gauge through which vacuum adjustment can be done as per our requirement.

CONTROL AIR RESERVOIR PRESSURE GAUGE:

This gauge is provided in side the nose compartment, it must always indicates 5 Kg/Cm^2 in the absence of this pressure load meter will not respond.

UNDER TRUCK EXAMINATION :-

There are two trucks provided on diesel locomotive. The centre pivot and two side bearers to bear the weight of top chassis. The following parts should be examined in the trucks while taking over charge of the locomotive.

1. Four coil springs on each side in each truck for proper position and condition.

2. Two sets of compensating beams [inner & outer] long & short must be examined for any cracks and tie – rod bolts securing both the pairs should be properly secured with nut and split cotters.

3. Sand pipes should be properly aligned to the rails.

4. Two brake cylinder COC's provided on right side of loco one on each truck should be in open position.

5. Oil must be available in both the side bearers and center pivot oil cups of each truck.

6. Collar pins securing the top frame and truck must be properly secured.

7. Air bellows provided on each traction motor must be examined for their condition.

8. Sander cut out COCk on each truck must be in open position.

9. The axle driven alternator provided on the left side no 2 axle must be examined for no damages on cables.

10. The speedometer gear box [pulse generator / speed sensor] and cables on right side no 2 axle must be intact.

11. The brake rigging pins and cotters must be intact and secured.

12. The piston travel on brake cylinders should not be more than 3" or 7 cm's.

13. The wheel must be checked for sharp flange or flat tire.

TRACTION MOTOR EXAMINATION:-

While TOC of the loco the following items must be examined inside the under truck on each traction motor.

1. Oil availability in both suspension bearing oil cups.

2. Both the axle caps are properly secured to the axle with four bolts and nuts.

3. The wick pads should be properly secured with four screws and sealed.

4. TM inspection covers and dust covers are properly secured or not.

5. No leakage of cardium compound from the gear case should be ensured.

6. Seven gear case bolts securing the gear case to traction motor must be properly provided and tightened. [4 vertical & 3 horizontal].

7. The four cables of the traction motor are properly hooked with wooden plugs and not rubbing against any moving part.

8. The resilient block securing bed bolts must be intact.

9. The brake rigging safety brackets are properly fitted or not.

NOTE: - If there is no oil in the suspension oil cups the loco should not be moved even as dead unless oil is filled. If any suspension bearing is running over warm also loco should not be moved to avoid damages to the axles and suspension bearing.

LOCO FRONT AND REAR SIDE EXAMINATION:

1. Both sides head lights and flasher lights must be intact.

2. Classification lights must be intact on both sides.

3. MU junction box should be properly secured.

4. CBC and screw couplings should be properly secured. Operating handle and safety pin should be intact.

5. Cattle guard and rail guard should be intact on both sides.

6. Hose pipes, BP pipes, FP pipes, MR & BC equalizing pipes should be intact on both sides

7. Hose pipe dummy should be available.

8. Both sides' buffers should be intact.

ITEMS TO BE CHECKED BEFORE CRANKING THE LOCOMOTIVE

1. Fuel oil tank balance.
2. All important and safety fittings in under gear should be intact in position.
3. Water level in expansion tank.
4. Lube oil level in expressor.
5. Engine sump oil level before and after cranking.
6. Engine governor oil level.
7. Main generator gear case oil level.
8. In driver's cab all operating handles must be intact in position.
9. All lights must be in working order.
10. No leakage of lube oil, fuel oil or water from radiator compartment, expressor room, engine room free end and power take off end and generator room.

CAB INSPECTION BEFORE STARTING THE DIESEL ENGINE:-

Before starting the diesel engine ensure the following in the dead loco.

1. Hand brake in applied condition.

2. On the operating control stand insert A_9 handle and keep in release position and SA9 handle in application position.

3. Insert reversor handle and keep it in neutral position.

4. Selector handle should be in OFF position.

5. On the non working control stand A9 and SA9 valves should be in release position and selector handle should be in OFF position.

6. A_9 feed valve COC should be in open position in working control stand and in close position in non working control stand.

7. MU stop switch should be in RUN position in both control stands.

8. MU2B should be in lead position.

9. On the control panel all the breakers should be in OFF position.

10. Check the ground relay if found tripped, reset the same.

11. ECS should in IDLE position.

12. In side the control compartment GR seal should be intact.

13. VRP, BN & BX cards must be secured properly and fuse must be available.

14. In side the nose compartment battery knife switch should be in OFF position.

15. GD80D, GD80E filters should not be having any cap and secured properly.

16. Available COC in nose compartment [6 no's] should be in open position. i.e. Horn COC, Wiper COC, A_1 Differential pilot valve COC, Banking COC, 28VB COC and N_1 Reducing valve COC.

MOVING THE LOCO

1. Ensure that the control air reservoir COC is opened and pressure is available to a value of 5 Kg/Cm^2 and drain the reservoir for some time.
2. Ensure that air and vacuum gauges are indicating 'normal'. Check the brake pipe COC is 'open' in the operating control stand and 'closed' in the non-operating control stand.
3. Satisfying the loco independent air brake efficiency by the gauge and also by observing the brake pistons having moved out cylinders. If brake pistons fails to come on re-check the independent air brake adjustments.
4. Place reversor in the required direction, selector handle should be placed in no.1, if frequent change in direction is required to be made, other wise put the reversor either forward or reverse direction and lock it by moving the selector no.4.
5. Place ECS to 'RUN' and close both GF switches (generator field switches) on both the control stands.
6. Sound the horn, release SA9 brakes, operate vigilance pedal if provided and open the throttle to no.1 and as the loco moves have a watch over the load meter pointer.

SECURING THE LOCO

1. Ensure the throttle is closed and bring the train to a stop by A9 application and SA9 after stopping.
2. Place reverser handle in neutral, selector in zero, switch 'OFF" both GFs and move ECS to idle.
3. After securing the loco as said above, only the Driver must leave the seat either in shed or at stations, en-route where the train stops for different reasons. Now the A9 can be released for creation of vacuum so that restarting the train will be easy with the train brakes in fully released condition.

4. If the Driver desires to leave the loco, he must remove the reversor handle and keep it in safe custody. The Asst. must be in the loco as the engine is in running.

SHUTTING DOWN THE ENGINE

1. Ensure that the battery ammeter is on charging side, and radiator fan has stopped.
2. Press the engine stop button till the lube oil pressure drops below 1.3 kgs/sq.cms and the white starting indication light comes on.
3. Switch off MFPB, MCB on both control stands.
4. Also switch off FPB, CCEB, AGFB and Control breakers on the control panel. Disconnect battery knife switch, apply hand brake, remove reversor handle and keep it in safe custody

FLASHER LIGHT

It is safety fitting provided in DSL locomotives. It is fixed by the side of the head light on either side. These are controlled by two numbers of individual units provided in drivers cab.

PURPOSE: - These lights are provided to be used by the driver in case of distress. When ever the driver wants to warn the approaching train in opposite direction about any blockage / infringement of the track. It can be even used when the driver wants the approaching train drivers assistants in case of inability.

FUNCTION / OPERATION: - The flasher light bulbs are having two numbers of filaments. If the first filament is fused by changing the switch position the second filament can be used. The flasher light control unit having two numbers of switches.

1. Master switch is having ON and OFF positions.
2. Filament selector switch with FL1 and FL2 positions.

While taking over charge of the loco the driver must ensure the flasher lights at both sides for proper functioning.

TESTING: - first switch ON master switch to ON position and observe the light glowing or not. Again change the filament selector switch to other position and observe the light for glowing.

AIR FLOW INDICATOR

The air flow indicator gauge is consisting of a white indicator that registers against a scale on the dial together with a red reference to the pointer attached knurled knob, which can set manually in any desire position. The scale of the air is graduated in terms of number of wagons in such a way that 60 marks corresponds to the maximum rate of flow that can be accepted to over come the leakage on a sixty wagons train.

Instructions to drivers:

1. Ensure continuity of BP in the formation without air leakages, BP in the loco should be 5 kg/cm2.
2. After a white needle come to stand still position align the red needle exactly over white needle with the help of the knob.
3. While working train on run other than A9 handle application any leakage of BP in the formation due to any reason.
   a. Train parting
   b. BP pipe un coupled or burst
   c. Guard applied brakes
   d. Chain pull

   White needle will be shooting up towards right side.
4. Any BP angular coc close on run is indicated by dropping of white needle towards left side.
5. Stop the train and attend the same for BP continuity .
6. Start the train only after both needles coincide

DUTIES OF THE DRIVER WHEN HE NOTICES A FLASHER LIGHT IS GLOWING

On run if the driver notices that the flasher light of the approaching train in opposite direction is glowing. The driver should switch ON and OFF for three times for acknowledgement [with master switch] immediately control the train speed to stop, and then proceed with 20/10 KMPH up to the point where he noticed the flasher light. [SR. NO – 6.03.7]

Attachment of dead loco to any train / light engine :

The following condition can be shall be satisfied before attachment of dead locomotive to any train / light engine.

Condition for attachment of dead locomotive

1. Certificate for fit to run is issued by section engineers / loco inspectors /PRC for / passenger /goods trains.
2. Maximum permissible speed of the dead locomotive shall not be less than maximum permissible speed of the train.
3. Arrangements have been made to ensure that brakes can be applied on dead locomotives in synchronization of with working locomotive.

4. Running of double /triple headed is permissible on the section over which the dead locomotive is to be hauled.
5. When a dead electric locomotive has to be moved on a non electrified section, special check shall be made regarding its infringement to the schedule of maximum moving dimensions. In the case of any infringement, the dead locomotive shall also check it at subsequent staff during the journey.

Attaching /hauling of dead locomotives by passenger train:

1. Only one dead locomotive (DSL/ELEC) can be attached.
2. Brake power of the train should be 100% excluding dead locomotive.
3. The dead locomotive can be attached next to train engine only.
4. As far as possible brake should work on dead locomotive. However if it is not possible, then in the case of air braked train brake pipe and feed pipe of working locomotive shall be connected to brake pipe and feed pipe of trailing stock and dead locomotive will work as piped vehicle . In the case of vacuum braked train vacuum pipe of trailing stock and the dead locomotive shall be treated as piped vehicle. If the locomotive is fitted with pure air brake system and vacuum pipe is not provided on locomotive then it should be attached with air brake trains only.

Attaching / hauling of dead locomotive by goods trains:

Movement of maximum three locomotives (two working + one dead) with lead is permissible subject to observations of all restrictions on operation of double/triple headed working locomotives in the section provided that brakes in dead locomotives are operational.

TRAIN PARTING

The train parting is an un foreseen dividing of train into one or more portions while the train is on run and just on the move.

1. Ensure the authorized load on the train and coupling with hose connections.
2. Ensure that the train is free from the brake binding. Also ensure the correct vacuum / BP level.
3. In case of CBC coupling before starting push back the train for approximately half a wagon length to make the CBC locks to fall on its locking position.
4. While pushing do not allow to rolling back.
5. Move the train forward after the rear movement of the train has stopped.
6. In case of screw coupling release the independent brake after opening throttle to first notch.

7. During starting if load meter shoots rapidly, do not advance further and try for another start.
8. Do not close the throttle to idle suddenly before restarting to the another start.
9. Apply independent brake with throttle in first notch position and then close the throttle to idle.
10. Before train starts moving, do not go more than four notches.
11. Do not allow more than 650 amps starting current with MU locos and double head working.
12. While starting from curves and turn outs apply power smoothly.
13. While notching up observe the load meter for sudden changes.
14. Allow the forward and reverse transition at the possible lower notch.
15. Close the throttle gradually.
16. Apply dynamic brake and train brakes smoothly.
17. Whenever it is required to accelerate after slowing down ensure full creation of vacuum/BP pressure level.
18. Ensure rising trend vacuum/BP pressure while stopping.
19. Do not apply independent brake before the train comes to dead stop.

COMBINED TRAIN REPORT (CTR/ T720)

Combined train report is a document jointly prepared in triplicate / by guard and driver giving details of train operation.

These details help to study various statistics.

Such as GTK, NTK, load , pre departure detention , TE Kms, shunting and detentions at stations and signals , loss/ gain in running train , cautious drive time taken , accident ,weather condition , stalling , parting , dividing ,ensure failure ,dead ensure movement, assistant engine used ,home shed of the locos used ,type of locos ,type of coaches ,wagons ,fuel consumption and for payment of crew. Therefore it is a vital document and all the relevant columns to be filled properly by the crew.

One copy of document goes for payment, one copy for statistical cell and one copy for drivers fuel consumption study purpose. If the CTR is missing ,the relevant performance of the locomotive such as TE kilometers ,GTK , fuel consumption ,SFC ,average load , TE hours ,shunting hours , LE hours will not be accounted fuel issued to locomotives will be accounted , resulting in under performance of the locomotives.

CTR is also essential for a enquiry conducted in the event of stalling, parting, accident, ensure failure and time loss.

Over time of crew basing of duty hours and kilometers earn are also based on CTR. It helps crew controller to utilize crew who worked less than stipulated hours, thus avoid over time payment and proper utilization of crew.

The rail way performance depends on punctuality, net ton carried, GTK carried, average load, speed LE Kms and idle hours etc.,which gives how asset are utilized . This statistic will not give a correct figure in the event of CTR is missing. There fore LF/ running is responsible for proper accounting of CTRs duly numbering the CTRs before issuing. Column N' of CTR is provided for this purpose. There are 22 columns are provided of the CTR .

Various forms are used for fuel oil accountal purpose:

HSD 1: This will be prepared by IOC and sent to RCD. In this invoice particulars of rail tanks allotted to RCD will be recorded.

HSD 2: It will be maintained at RCD in which the details of HSD oil rail tankers are dealt with the RCD .

HSD 3: Monthly statement of en-route shortage due to pilferage.

HSD 4: Storage tank register dealt individually.

HSD 5 : Daily stock register. This register shows the total transaction of day ie total receipts with cumulative quantity and daily total issues and cumulative totals with opening balance on daily basis and also closing balance on daily basis.

HSD 6: Monthly statement of issues made to home shed /out station shed/foreign railway locomotives.

HSD 7: HSD oil issued for miscellaneous purpose to other departments will be recorded.

HSD 8: HSD oil issued for miscellaneous purpose (of mechanical department) will be recorded.

HSD 9: A statement submitted by in charge of RCD at the close of the month with details of monthly receipts, issues and closing balance at the end of month. Submitted to DME/P, Sr DAO, COM (F) and FA&CAO .This is other wise known as balance sheet.

HSD 10: Fuel clerk who makes issues to locomotives, maintain fuel checkers diary.

HSD 11: Contamination testing register.

F12: Fuel voucher .This will prepared in triplicate by the fuel issuer. In this incoming balance ,issued quantity, out going balance, no.of locos, loco number , home shed will be entered duly making driver ,shunters signature. One copy will issued to driver this is to be attached to the CTR by the driver , second copy will sent to accounts and third copy is office copy.

F25: Survey report.

Drivers technique to achieve fuel economy

1. Driver should be thorough in sectional knowledge.
2. Before leaving shed check the loco thoroughly. More over, check whether previous drivers booked repairs attended or not. If not, attend and leave shed.
3. Before starting ensures that the train is in released condition (through air flow indicator and pressure gauges.
4. While notching up maintain minimum interval of five seconds between notches to avoid
    a) Improper combustion of fuel.
    b) Production of hot gases with oil, which will develop cracks in the exhaust manifold on long run.
    c) Less BAP due to hot gases leaking through cracks, thereby wastages of fuel oil .
5. Come to 8th notch as early as possible duly avoiding wheel slip and double notching up.
6. After achieving booked speed he should bring down the notch and keep in one position to maintain booked speed and as per the grade, he should notch up and down at minimum times.
7. Utilize all the opportunities of coasting.
8. Avoid brake binding,, running with brake binding and dragging the train causes not only the wastage of fuel oil and there is a chance of derailment. So when ever train comes to stop due to brake application give minimum release time and to restart after it releases completely.
9. If the second forward transition is not picking up at the correct speed use manual transition.
10. Where ever section and load permits try to shut down rear loco.
11. Where ever short detentions are there make use of low idle RPM switch there by saving of 5 to 8 lts of fuel oil per hour.
12. If the detention is more than 30 minutes, shut down the loco duly checking the battery ammeter and contacting section / power controller.
13. When ever any problem experienced on run try to attend it if not book the repair so that it can be attended at home shed on arrival.

14. The driver should no about trip rations of his trains the section and able to calculate trip ration correctly.
15. He should see that the guard should write the correct load particulars and while HOC and TOC of HSD oil should be taken for correct accountal of fuel oil consumption.

FUEL TRIP SHEET:

It is important to know about the various particulars that are to be filled in the "TRIP SHEET" made available in the DSL locos working on line by the working crews. The particulars filled by the crews in the Trip Sheet will be taken as the base for working out the fuel / lube oil consumption, GTKM. SFC. Shunting and shutdown particulars for various purposes.

On one side of the Trip Sheet the crew has to enter the following details. i.e, S.No., Date, Driver's Name / Home station. Train No., Service, single head "MU" Triple. Time of loco on to train. Time of loco detached from train. Section From- to- Division. Distance. No. of vehicles load in tones.

On the other side of Trip Sheet the following particulars are to be entered by the train crew. They are:-

Place, Duration in hours / minutes. Detention in yard station in hours minutes, loco shutdown hours / minutes . Train hours – Departure / Arrival. Fuel consumption particulars. Taken over / En-route fueling / place of fueling / Handed over balance, lube oil consumption particulars. Taken over Added en-route / place added handed over balance , remarks, signature of the driver.

The inspecting officials carrying out footplate inspection shall check the trip sheet and ensure that the crew fills in the columns properly and if required educate the crew about how to fill the same and about its importance.

NTKM: Net tones means the weight of consignment.

KM means distance traveled. Therefore NTKM means weight of the consignment x distance in km. Assuming tare weight (empty) of a wagon is 10 tones and the consignment weight is 5 tons the total load as 15 tons. Therefore net tons help to work out trailing load of a train. Further increasing NTKM means more loading of consignments (such as iron ore, coal, cement etc.,) less NTKM means less loading.

GTK: means gross tone kilometers. Gross mea ns engine tone kms + train tone kms. Therefore

GTK = (Engine weight x distance traveled) + (train w x distance)/1000
(GTK is generally is used in terms of 1000 GTK as one unit)

Increase in NTKM will increase in GTKM, therefore to increase or to decrease the trains required to run depends on GTKM s . earned or to be earned . specific fuel consumption is also studied basing on fuel consumption for carrying one thousand tones to a distance of one km.

Home railway, foreign railway locos earned GTKMs separately worked out to give credit to foreign railways for financial adjustments . more GTK in less no. of train means increase in average load thus better utilization of assets (Engine ,crew , wagons & fuel consumption).

SFC:- Specific fuel consumption is called SFC. Specific is refereed to certain conditions /parameters. Generally SFC is used in terms fuel consumed in carrying 1000 tones to a distance of 1 km.. this is otherwise called as "Liters consumed for 1000 GTK" or SFC for 1000 GTK. It is seen from the above there are two conditions/parameters laid down.. one is the load second is the distance . These parameters / conditions are refer ed as "Specific ".

ENGINE KILOMETERS (EKM)

Kilometer earned by a locomotive is called Engine Kilometer. If a locomotives better utilized it will earn more kilometer/thereby better utilization. If under utilized, it will give less kilometers. Therefore average Engine utilization per day per Engine Kilometers earn, when compared daily will gives us the performance of locomotive. This can be verified, section wise and division wise and suitable action can be taken for improving performance.

While working Mail/Express entire links K.M./Day/Loco should not be less than 500 K.Ms. If more than 500 K.Ms. it is better utilized. And if less than 500 K.ms. is under utilized. Similarly target utilization and Goods all sections/divisions will give us the performance, when compared daily utilization.

Engine Kilometers are maintained at

1. Control Office
2. Diesel sheds
3. Statistical Cells

NET TONNES KILOMETER (NTKM)

Kilometer means traveled. Therefore NTKM means weight of consignment X distance in kilometers. Assuming tare weight (empty) of a wagon is 10 tonnes in the consignment weight is 5 tonnes, the total load is taken as 15 tonnes. Therefore net tonne helps to work out trailing load of a train. Further increase in NTKM means more load of consignment (Such as iron ore, coal, cement etc.,) Less NTKM means less loading.

GROSS TONNES KILOMETER (GTKM)

Gross means Engine tonne kms. + Train tonne kms. Therefore GTKM = (Engine weight x distance traveled) + Train weight x distance) /1000 (GTKM is generally used in terms of thousand GTK has one unit)

Increase in NTKM will increased in GTKM. Therefore to increase or to decrease the trains required to run depends on GTKM earned or to be earned. Specific fuel consumption is also studied basing on fuel consumed for carrying one thousand tones to a distance of one kilometer.

Home Railway, Foreign Railway locos earns GTKMs separately worked out to give credit to foreign railways for financial adjustments. More GTKM in less no. of trains means increase in average load thus better utilization of assets (Engine, Crew, wagons and fuel consumption)

TIPS TO THE DRIVERS IN MODIFIED LOCOMOTIVES

1. In some locomotives, both the control stands have SA9 cut out Cocks . Both control stand SA9 COC should be always in open condition . If SA9 valve continuously blowing or SA9 brake valve defective , that time the defective SA9 valve cut out Cock should be close.
   Driver's note: Always SA9 COC should be in open condition unless there is a problem in SA9 brake valve.

2. After removal of lube oil bye pass valve from locomotive, engine will shut down due to low lube oil pressures are varied in notches.
   In GE governor locomotives up to 6th notch if LOP drops below 1.3 kg/cm2, engine will shut down due to operation of OPS1 . And if LOP drops below 3.5 kg/cm2 in 7th and 8th notches engine will shut down due to operation of OPS2.

   Driver's note: Sudden throttling should be avoided . Otherwise if LOP not build up to 3.5 kg/cm2 in higher notches engine will shut down due to action of OPS2 .

3. After fitment of Release –Run valve in Auto flasher light modification locomotives , on run if A9 applied and released BP should be charged above 4.4 kg/cm2 within one minute. Otherwise Auto flasher lights , buzzer, LED will glow and engine will come to idle.
   Driver's note: After releasing A9 , BP should charge quickly . If not charging quickly, operate SP1 or SP2. (these switches are provided on both the control stands.)

4. Locomotives fitted with Electro pneumatic governor (EPG) : In these locos EPG toggle switch is provided . Generally this toggle switch will be at 'ON' position. But in MU if both the locos are provided with EPG, then one loco EPG toggle switch must be in 'OFF' position .
   Driver's note: In MU, if both locos are fitted with EPG and both locos EPG toggle switches at 'ON' , then due to uneven matching of loading and unloading causes to complete MR will drop.

5. After introducing of Twin beam head lights in locomotives, driver's to be note that both control stand head lights should not be switched 'ON' at a time. If both control stand head lights switched 'ON' causes to failure of head lights . So in one control stand head light to be switched 'ON' and in another should be in 'OFF' position

DIFFERENCES BETWEEN VACUUM BRAKE AND AIR BRAKE SYSTEM

VACUUM BRAKE SYSTEM	AIR BRAKE SYSTEM
Brake power deterioration is more	Reduce brake power deterioration
Braking distance is more	Shorter braking distance
Braking force is less	Higher braking force
Brake power over trains length is not uniform	Uniform brake power over trains length
Not suitable for heavier and longer freight trains at higher speeds	Suitable for heavier and longer freight trains at higher speeds
Needs heavy equipment, greater maintenance needs	Compact and light equipment, lesser maintenance needs
Atmosphere air is used for getting braking force.	Compressed air is used for getting braking force
Distributor valve assembly is not provided.	Distributor valve assembly is provided.
Auxiliary reservoir and dirt collector is not provided.	Auxiliary reservoir and dirt collector is provided.
Cut off angle cock is not provided	Cut off angle cock is provided on the brake pipe either end of each wagon
Vacuum continuity test is required	Air continuity test is required
Twin pipe system is not available	Twin pipe system is provided in coaching trains
During ACP train will stop automatically	During ACP driver has to stop train after observing drop in BP pressure and audio visual alarm.
During brake application piston moves upwards	During brake application piston moves outwards
Excess release time	Less release time stop and start quickly
IR washers are used between hose pipe connections	MU washers used between air hose connections
Brake cylinder is divided in to train space and chamber space portion	Brake cylinder is not divided
Vacuum shall be created in the train pipe from locomotive.	Compressed air is supplied to the train brake pipe from locomotive.

WORKING OF A TRAIN WHEN HEAD LIGHT IS DEFFECTIVE

If the head light becomes defective during the hours of darkness and or thick and foggy weather , the driver should ensured the following to work the train further .

1. Ensure both side buffer beam marker lights are burning .
2. The train should work cautiously at a speed of 40 kmph for BG and MG.
3. Give continuous whistle without fail.
4. Observe any caution order of less than 40 kmph in the section .
5. Stop the train at next station irrespective of schedule stop or not , in case of goods train if the signals are given through stop the train at the station itself duly clearing the fouling mark.
6. Try to replace the head light bulb with the spare bulb.
7. If the head light is working after replacing work the train in same condition duly informing to section controller / PRC.
8. If the head light is not working even though after replacing inform to PRC and take his advice and act accordingly.

HORNS NOT WORKING

1. While taking over loco from shed or train ordering station when horns are not working should not leave , unless rectification (or relief) to be arranged.
2. While working train on run if it happen in mid section , clear the section a very cautious speed (driver should be prepared to stop the train short of any obstruction) and the same to be informed to PCOR/ shed and take advice.

PILOT LAMP NOT WORKING

1. While taking over loco from shed or train ordering station when pilot lamp not working should not leave , unless rectification or relief should be arranged.
2. While working train ,on run if not working contact PCOR / shed and take advice.

BY PASSING OF WAGON/ COACH IN TWIN PIPE WORKING SYTEM

If the brake pipe line under the wagon / coach has cracked or broken causing heavy leakage of air the wagon / coach can be by passed by connecting feed pipe line of the defective wagon/ coach to the broken pipe line of the adjacent wagon/ coach have to be removed and replaced by feed hose pipe in place brake hose pipe. Then feed pipes can be coupled up, therefore this wagon/coach will be by passed via feed pipe line and brakes will not effective on this wagon/coach .

Therefore twin pipe working will have to be discontinued. In this case by closing the feed pipe coc of the locomotive and the train has to be worked with single pipe operation.

POSITION OF DIFFERENT DRAIN COCKS AND CUT OUT COCKS :

1. **MR_1 DRAIN COCK: -** Available on loco left side on MR_1 should be in closed position. This should be opened frequently to drain out the moisture from the MR_1.

2. **MR AUTO DRAIN VALVE COC: -** Provided on loco left side should be in open position. To drain out the moisture from the MR tanks.

3. **FEED VALVE COC [1"COC]:-** Provided on loco left side above MR_1 should be in closed position. It should be opened only during working of train in twin pipe operation.

4. **SANDER COC: -** Available on loco right side one on each truck should be in open position for working of sanders.

5. **MR_2 DRAIN COCK: -** Available on loco right side on MR_2 should be in closed position. It should be opened frequently to drain out moisture from MR_2.

6. **J - FILTER DRAIN COCK: -** Available on loco right side above MR_2 should be in closed position. It should be opened frequently to drain moisture from J- filter.

7. **BRAKE SYSTEM COC: -** Available on loco right side near J-filter should be in open position for working brake system.

8. **BRAKE CYLINDER COC: -** Available on loco right side each one on each truck should be in open condition so that particular truck brakes will be applied.

9 . **FEED PIPE ANGULAR COC: -** Available on front and rear of the locomotive should be in closed position. While working of twin pipe operation the working side COC should be open.

10. **BRAKE PIPE ANGULAR COC: -** Available on front and rear of the locomotive should be in closed position. It should be opened towards working side during MU operation and towards working side in air brake formation.

11. **BRAKE CYLINDER EQUALISING COC: -** Available on loco front and rear should be in closed position and it should be opened towards working side during MU operation.

12. **MR EQUALISING COC: -** Available on loco front and rear should be in closed condition and to be opened towards working side during MU operation.

13. **WIPER COC: -** Available in nose compartment should be in open position for working of wiper motors.

14. **BANKING COC: -** Available in nose compartment should be in open position. It should be closed only during banker operation only.

15. **28 VB COC or STRAINER COC: -** Available in nose compartment should be in open position. It should be closed when conjunctional brakes are not getting release even though A9 Automatic brake valve released.

16. **N-1 REDUCING VALVE COC: -** Available in nose compartment should be in open position.

17. **HORN COC: -** Available in nose compartment should be in open position.

18. **CONTROL AIR RESERVOIR DRAIN COCK: -** Available in nose compartment should be in closed position and should be opened to drain out moisture from control air reservoir.

19. **A1 DIFFERENTIAL PILOT VALVE COC: -** Available in nose compartment should be in open position.

20. **A9 FEED VALVE COC: -** Available in each control stand should be opened in working control stand and to be closed in non working control stand.

21. **HB 5 VALVE COC: -** Available in side the long hood control stand. It should be in open position and to be closed if it is coming in to action during A 9 application .

22. **¾" COC: -** Available in driver's cab near short hood control stand driver seat, should be in open position. It should be closed in trailing loco of MU and in banker loco while banking the AIR brake formation.

23. **LWS COC: -** Available in expresser room should be in open position.

24. **AC GOVERNOR COC: -** Available in expresser room should be in open position. It should be closed only if sufficient MR pressure is not building up.

25. **WATER MAIN DRAIN VALVE: -** Available in expresser room should be in closed position and in sealed condition.

26. **LUBE OIL FILTER DRUM DRAIN COCK: - [ONE or TWO]** Available on filter drum in radiator room, should be in closed position.

27. **STRAINER DRAIN VALVE: -** Available on engine left free end should be in closed position

SAFETY FITTINGS IN DRIVER'S CAB:

1. Head light.
2. Flasher light.
3. Hand brake.
4. Horns
5. Speedometers
6. Look out glass
7. Wind shield wipers with motors
8. DI emergency (fireman emergency)

SAFETY ITEMS IN DRIVER'S CAB:

1. Portable telephone with poles with seal
2. Fire extinguishers
3. Spare BP & Vacuum hose pipes
4. Spare transition screw coupling
5. Safety 'U' bracket
6. L- rod
7. Spare VRP fuse
8. Spare head light bulb

SAFETY FITTINGS IN UNDER TRUCK:

1. CBC coupling safety pin
2. Cattle guard should be 10" above the rail.
3. Rail guard should be 4" above the rail.
4. Compensating beam safety U bracket (trunion bracket) , Tie rod bolt with cotter.
5. Vacuum hose pipe dummy.
6. Truck collar pins and safety U bracket.
7. Brake hanger tie bar with safety chain.
8. TM gear case bolts(4-vertical,3-horizantal)
9. Axle box stay plate with bolts.
10. Brake pull rod with safety U clamp
11. TM power cable secured with wooden cleats.
12. Sand pipe with proper alignment.

SAFETY DEVICES IN LOCOMOTIVE

1. **HB5 AIR RELAY VALVE:-** This valve with COC provided inside the long hood control stand or nose compartment .when ever vacuum on train pipe gets reduced to below 38cmsdue to any reason other than A9 application(ACP, Train parting,D1emergency application, guard application). This valve will come in to action and PCS1 will be knocked out and brings the engine to idle and auto flasher lights will come.

2. **DEAD MANS RELAY: - [DMR]** This relay is provided inside the control compartment. When ever PCS knocked out this relay will get de energized and engine will comes to idle, throttle will not respond.

3. **GROUND RELAY: - [GR]** It is provided in control compartment. When ever there is earth faults in control circuits and in power circuits this relay will be operated. Resetting knob will be projected out and its pointer will co insides with red dot, bell will ring, white light will glow and engine will comes to idle and load meter will drops to ZERO.

4. **GFOLR [GENERATOR FIELD OVER LOAD RELAY]:-** This is provided in all AC/DC locos. It is provided in control compartment. When ever over load current flows to the rectifier panel and main generator [Alternator] shunt fields, GFOLR will be tripped and brings the engine to idle, load meter will come to ZERO and over load indication lamp will glow, bell will ring. To reset the GFOLR close the throttle, keep ECS in idle, press the GFOLR reset button. If the GFOLR does not get reset then reset manually. If the GFOLR trips more than three times it should not be reset and loco should be failed.

5. **OSTA [OVER SPEED TRIP ASEMBLY]:-** This unit is provided in engine right side free end. When ever engine RPM exceeds its limit loco will shut down without indication to protects the engine from over speeding damages. With out resetting OSTA starting the diesel engine, engine will crank but not fire.
   Note: If OSTA tripping , do not try to re crank several times otherwise batteries may be discharged.

6. **OPS 1 & 2 [OIL PRESSURE SWITCH]:-** These are provided in drivers cab. When ever lube oil pressure drops below 1.3kg/cm^2 in 1 to 6th notch, the OPS1 will operate and makes engine to shut down with indication (bell and low lube oil on LED panel). Similarly during 7th & 8th notch if lube oil pressure drops below 3.5kg/cm^2, the OPS2 will operate and makes engine shut down with indication (bell and low lube oil on LED panel).

7. **LOW LUBE OIL BUTTON (LLOB):-**

LLOB is available in wood ward governor. In WW governor locomotives, LLOB operation set at 1.3kg/cm^2 in idle and 3.5Kg/cm^2 in 8th notch. Depends upon the notch working engine will shut down with indication .(bell and green light glowing on LED panel).

8. **L.W.S. [LOW WATER SWITCH]:-** It is provided in expresser room. When ever water level in the expansion tank drops to one inch below from the bottom of the tank LWS will operate and makes engine to shut down with indication of HEA in LED panel.

9. **S.A.R. [SAFETY AUXILIARY RELAY]** :-

This is provided in control compartment. This relay will get current from Tacho generator. It is provided in the G.E. governor locos only. When ever any electrical disconnection in the speed circuit then this relay will protect the engine from over speeding. This relay is connected in series with governor speed coil. It will be in energized condition when the engine is in running. In case of current reduction SAR will be de-energized and cut off the supply to the clutch coil and engine comes to shut down with out any indication.

10. **W.S.R. [WHEEL SLIP RELAY]:-** There are three wheel slip relays are provided in control compartment. These are connected in series parallel / parallel to the traction motor combination. When ever uneven current flows to the traction motors the particular WSR will be operated, power reduction in load meter and audio visual indication will come to alert the driver. Sanders will operate automatically. Immediately notches to be reduced as for as possible for a lap of time.

11. **EXPLOSION DOOR:-**This is an operable door fitted on both the sides of the engine crank case in place of sump inspection door. Bursting of explosion door happens on two occasions.

A. when the crankcase exhauster failed and furthers it is neglected by the driver for a long period of time.

B. when any hot bearing or any other moving parts gets over heated and emitting heavy smoke inside the crankcase beyond the capacity of the crankcase exhauster motor then explosion door get opened. It opens and closes since it is a danger indication that some parts of engine over heated inside the crankcase.

12. **ETS [ENGINE TEMPERATURE SWITCH] :-** It is provided in expresser room. When ever water temperature rises to 90`C this switch will operate and makes bell to ring and HOT engine indication will come to alert the driver.

CONDUCTING OF TEN TESTS ON DIESEL LOCOMOTIVE

After attending schedule, before taking over charge, the loco has to be examined in dead condition. Then crank the diesel engine and allow it to warm up for some time. While engine is running examine the loco for any leakages of oil / water. Then conduct the following ten tests to ensure good fetal working of locomotive.

1. **ENGINE RPM TEST: -** keep A9 in release position, SA9 in application position, reversor in neutral, GF switch in OFF position, selector handle in NO 1 position, ECS in run position. Advance the throttle notch by notch, the RPM of the engine will raise with respect to the notch position, watch the increase of the RPM by every notch.

PURPOSE: - This test is conducted to know the throttle is responding properly. This will show that the governor is functioning properly. This will show that the control drum interlocks are in good condition.

2. **A9 EMERGENCY TEST: -** Keep ECS in RUN position, reversor in neutral, GF in OFF position, SA9 in application position. After advancing the throttle to higher notch position gradually move the A9 handle to emergency position. The following deflections take place.

   A. BP pressure will drop to ZERO.
   B. Vacuum train pipe needle will drop to ZERO.
   C. Brake cylinder pressure rises to 2.5 $KG/CM^{2.}$
   D. Engine RPM returns to IDLE irrespective of the notch position by the action of PCS2 gets knocked out and DMR is de energized. Move A9 handle to release position, the PCS & DMR will pick up and brake pipe pressure and vacuum indication will be restored.

   PURPOSE: - This test is done to check the condition of PCS2 there by the special feature of the EMERGENCY position of A9 handle.

3. **D1 EMERGENCY TEST: -** Keep ECS in RUN position, reversor in neutral, GF switch in OFF, selector in motoring 1 position, SA9 in application position. Advance the throttle to higher notches and then open the D1 emergency valve lid. Vacuum train pipe needle drops to ZERO. Vacuum reservoir needle drops to 25cms and brake cylinder pressure rises to 2.5 KG/CM^2 engine RPM will returns to IDLE along with auto flasher lights. Move the throttle to IDLE, close the D1 emergency valve lid, vacuum is restored PCS1 & DMR will pick up. If it is dual brake loco, for vacuum dropping, emergency valve lid to be opened to 45^0 and for dropping of BP this valve lid to be opened to 90^0.

PURPOSE: - This test is done to know the condition of PCS1 & P2 application there by ensuring whether the loco is fit in safety aspect during any emergency or train parting.

4. **BRAKE POWER TEST: -** Keep ECS in RUN, selector in motoring 1, GF switch in ON position, reversor in required direction, A9 in release, SA9 in application position. Open the throttle to first notch and watch the load meter, loco will attempt to move, but not to move up to third notch as loco brakes are in applied condition.
   PURPOSE: - This test is done to ensure efficiency of the loco brakes and also the load meter is responding or not.

5. **SANDER TEST: -** Keep SA9 in application, ECS in RUN, selector handle in motoring 1, GF switch in ON position, reversor in working direction. Open the throttle to first notch and close, now operate sander button on control stand. Sanding should be done as per the direction of the reversor position. Change the reversor position and repeat the same.
   PURPOSE :- Ensure the sanding arrangement, the sander magnet valve are working and sand hoses free from leakages or blockages and also BKT and REV switches are functioning properly.

6. **VACUUM EFFICIENCY TEST: -** Keep SA9 in applied condition, GF switch in OFF position, A9 in emergency position. Remove one side vacuum hose pipe from the dummy. Place 5/16'' or 8mm leak hole test plate and then keep A9 handle in release position. Vacuum train pipe will create 53 cm's of vacuum with in 3 to 5 seconds.
   PURPOSE: - This test will indicate the efficiency of the VA1B control valve, showing that the loco is capable of creating 53 cms of vacuum against the normal leakages on the formation.

7. **BLOCKAGE TEST: -** remove the vacuum hose pipe on one side of loco from dummy and keep it open to atmosphere. Move the A9 handle to release position. Vacuum should not be created more than 10 cm's. This will indicate that there is no blockage in the system.

8. DYNAMIC BRAKE TEST: - Move the loco on power and close throttle. Move the selector handle to braking side, loco speed should be reduced, load meter should indicate, BKBL will starts working and engine speed will raise to 4th notch RPM. Move A9 handle to over reduction position loco brakes should not get applied. This shows that BKIV valve is functioning and loco brakes are nullified. Then move A9 handle to emergency position then dynamic brake will cut-off and loco brakes will apply.
PURPOSE: - This test is conducted to check the dynamic brake equipments such as BKT, BKBL, BKIV are functioning or not.

9. RADIATOR FAN TEST: - Allow the engine in higher notch for some time and stipulate the temperature and watch the water temperature gauge and R1 whether picking up at the stipulated temperature.

PURPOSE: - After satisfying that the radiator fan is working, you can manually operate the R2 to see that the fan speed is increases there by ensuring that R2 is in good condition.

10. FLASHER LIGHT TEST: - Switch on both side flashers light switches and see that the lights are glowing dim & bright alternatively. Ensure that the both filaments of the flasher lights are in working order by switching on the filament switches.

PURPOSE :- These lamps are provided on the loco to be used by the driver in case of emergency. When ever the driver wants to warn the driver of the train coming in the opposite direction, about any blockage or infringement of the track. It can be even used when he wants his assistants in case of desirability of his loco. On seeing this flasher light the driver of the opposite train will reduce the speed of his train and he look forward for any obstruction.

PREPARATION OF MULTIPLE UNIT OPERATION

Before farming MU operation decide which loco should be in leading and which loco should be in trailing. Crank both the diesel engines individually and conduct 10 tests in both the locos independently. Then allow leading engine to be idling come to the trailing loco and couple the trailing loco to the leading loco as follows.

1. Couple up the CBC coupling. And provide safety pin on both sides.
2. Couple up the vacuum hose pipe.
3. Couple up the MR equalizing hose pipe.
4. Couple up the Brake cylinder hose pipe.
5. Couple up the BP pipe.
6. Couple up the FP pipe. { for twin pipe working }
7. Couple up the electrical MU jumper cable.

SETTING OF EQUIPMENT IN MU OPERATION.

SL NO	ITEM NAME	LEADING LOCO	TRAILING LOCO
1	A9 HANDLE	RELEASE	RELEASE
2	A9 FEED VALVE COC	OPEN IN WORKING CONTROL STAND AND CLOSE IN NON WORKING CONTROL STAND	CLOSE IN BOTH CONTROL STAND
3	SA9 HANDLE	APPLICATION	RELEASE
4	MU2B VALVE	LEAD	TRAIL / DEAD
5	¾' COC OF BP	OPEN	CLOSE
6	1' COC OF FEED VALVE	OPEN IF WORKING TWIN PIPE OPERATION]	OPEN IF WORKING TWIN PIPE PERATION]
7	BP ANGULAR COC	OPEN AT COUPLE END AND CLOSE IN FREE END	OPEN AT COUPLE END AND CLOSE IN FREE END
8	MR EQUALISING COC	-- SAME --	-- SAME --
9	FEED PIPE ANGULAR COC	-- SAME --	-- SAME --

10	BRAKE CYLINDER EQUALISING COC	-- SAME --	-- SAME --
11	REVERSOR	INSERT IN OPERATING CONTROL STAND AND KEEP IT IN NEUTRAL.	KEEP IT IN NEUTRAL AND REMOVE HANDLE

ELECTRICAL			
1	MFPB 1 & 2	PUT 'ON' ON BOTH CONTROL STANDS	PUT 'OFF' ON BOTH CONTROL STANDS
2	GF SWITCH	PUT 'ON' ON BOTH CONTROL STANDS	PUT 'OFF' ON BOTH CONTROL STANDS
3	MCB 1 & 2	PUT 'ON' ON BOTH CONTROL STANDS	PUT 'OFF' ON BOTH CONTROL STANDS

REMAINING BREAKERS TO BE PUT 'ON' ON BOTH LOCOS.

WHEN MU LOCOMOTIVES ARE SPLIT WHAT CHANGES ARE TO BE MADE IN THE TRAILING LOCO

Before splitting MU locos change the following in the trailing loco –

1. Keep MU2B in lead position.
2. A9 COC opens in the operating control stand and close in non working control stand.
3. Open ¾" COC near short hood control stand.
4. Switch ON MFPB, MCB, and GF on both control stands.
5. Insert A9, SA9 & reversor handles in working control stand.

6. Close the angular COCs of BP, FP and MR & brake cylinder equalizing at the couple end of the pipes to be disconnected and secure the same.

7. Un couple the vacuum hose pipes and secure it on the dummy.

8. Un couple the MU electrical jumper cable.

9. Now detach the loco to work single unit.

TRAIN HANDLING METHOD

INTRODUCTION

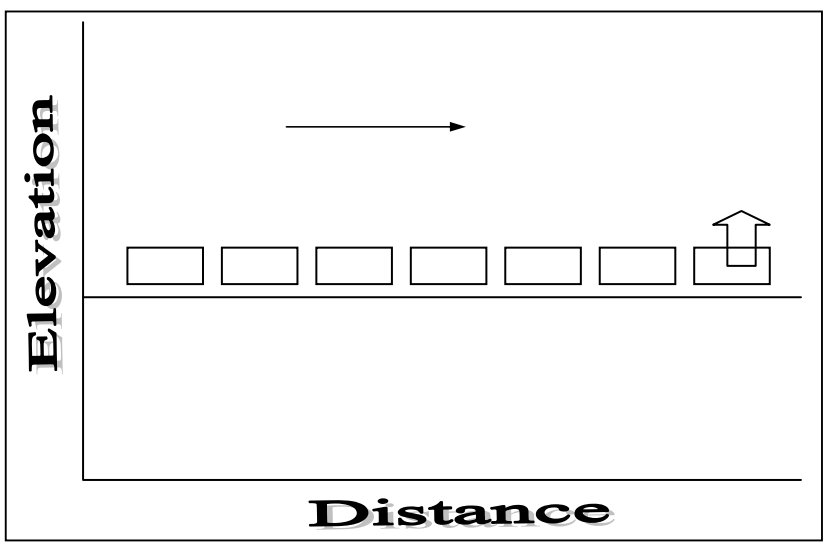
Driving is an art. As in any other form of art, the driving also differs from person to person because the degree of freedom in operation is more to the Driver.

The train driver should feel the following to handle the train smoothly.

- Load hauling [tractive effort]
- Draw bar pull
- Slackness in the train
- Brake power
- Terrain condition

LEVEL TERRAIN

General: Grades of less than 1 in 400 are termed as level terrain. Terrain of this type does not produce significant in train forces. However, high in train forces can occur due to improper use of throttle, automatic brake, independent brake and dynamic brake.



Starting:

1. Release the automatic brake
2. Open the throttle to first notch and simultaneously release independent brake
3. Note the load meter, when the load meter needle is stabilized, move to 2nd notch
4. Like wise move throttle up to 4th notch duly allowing pauses between notches
5. If the train starts moving in the stretched mode, increase throttle slowly to accelerate the train
6. Wait until the train has absorb the power from the present notch position before notching up.
    - ❖ If train does not move, even after moving throttle to 4th notch
        - ✓ Slowly reduce throttle to first notch
        - ✓ Apply independent brake
        - ✓ Check brake binding and other reasons for train not moving.

Accelerating

1. The acceleration of train depends on train make up
2. Load meter can be used as a guide for throttle handling
3. Notch up in the stretch mode to obtain balance speed/desired speed
4. Avoid slack while notching up

Negotiating [steady running]

1. Once the desired/balanced speed is achieved, reduce the notch to maintain the speed
2. Adjust the notch to maintain the speed
3. Frequent adjustment of notch is not advisable

Slowing

1. Reduce throttle slowly and allow to coast
2. Apply brake to decelerate rapidly
3. Either dynamic brake alone or dynamic brake with automatic brake can be applied in slack bunch method
4. Brake should be applied, considering the train speed, brake equipment, train make up and the state of slack prior to initiate the slowing down.

Stopping

1. Close the throttle gradually
2. Apply brake in slack bunch method
3. As the dynamic brake effect fades in lower speed, supplement application of train bracket stop the train
4. Apply independent brake, after train comes to dead stop.

Slack Bunch Braking Method

This can be done with either dynamic brake alone or with dynamic brake and automatic brake.

A. *Dynamic brake alone:*

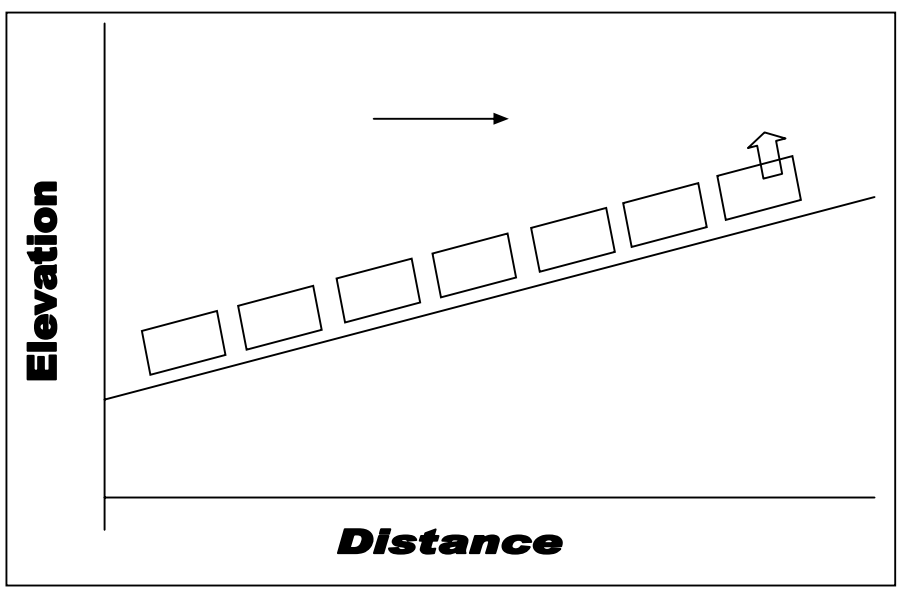
1. Bring the selector to zero mode
2. Bring the selector to big 'B' or 'D'
3. Note the Load meter for minimum reading
4. Gradually advance the selector handle to get desired braking effort
5. After the train speed is reduced to the desired level gradually release the selector handle to big 'B' or 'D'
6. Note the load meter for minimum reading
7. Release dynamic brake and resume to power mode of operation

B. *Dynamic brake and Automatic brake:*

1. Apply dynamic brake as stated above
2. Make minimum reduction application
3. Keep loco brake released
4. Gradually advance selector handle and make additional train brake application as required
5. Use cyclic braking if single application of train brake is not sufficient
6. Release the dynamic brake as stated above
7. Resume to power mode after the train brakes are fully released.

LIGHT ASCENDING GRADE

General: Grades of less than 1 in 100 are termed as "Light Ascending Grade". Slack stretched method of stopping prevents sudden high in train forces roll out when brakes are released.



Starting :

1. Fully release train brakes
2. Open throttle to one or two notch to hold the train, then release independent brake
3. Advance throttle further duly providing sufficient pause between notches
4. If the wheel slips reduce the throttle and apply sand

Accelerating:

1. Advance throttle until sufficient power is produced for train to reach the desired or balanced speed
2. Keep the train in slack stretch

Negotiating:

1. Adjust the throttle at the desired/balance speed
2. Keep the train in slack stretched

Slowing:

1. Reduce throttle slowly to keep the train stretched
2. As the throttle is reduced to one or two notch position, train speed will slow down
3. If throttle reduction alone is sufficient apply train brakes duly closing throttle to idle

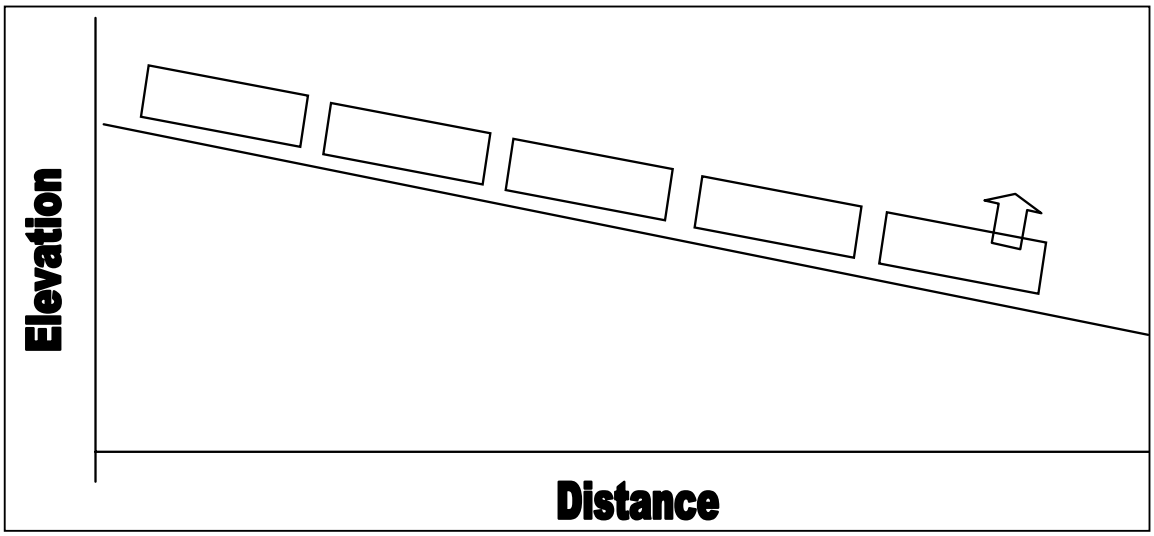
Stopping:

1. Use throttle reduction method as follows:
   - Reduce throttle gradually
   - After the grade stalls the train, fully apply independent brakes
   - Application of independent brake will allow the slack to stretch

2. Use automatic brake as follows:
   - Make minimum reduction application as soon as the throttle is closed
   - Make additional brake application as required
   - Apply independent brake fully after the train comes to dead stop
   - Stop the train with vacuum raising.

LIGHT DESCENDING GRADE

General: Grades of less than one in 100 are termed as "Light Descending Grades". Balance/desired speed can be reached. Dynamic brake can be used effectively to control the train speed.



Starting:

1. Open first notch
2. Release independent brake slowly to stretch the slack
3. Open subsequent notches after the slack is stretched
4. If the in-train forces are more, use slack bunch braking to control the speed.

Accelerating:

1. If the train is fully loaded, maintain the slack in bunched state with the help of dynamic brake and allow the train to accelerate.
2. In the above situation improper use of dynamic brake will cause run-out and run-in.
3. If the train is empty, sufficiently notch up, keeping the slack stretched.

Negotiating:

1. For loaded train, dynamic brake can be used for steady running.
2. In the above case automatic brake can also be supplemented to control speed.
3. For empty train, steady running can be maintained by lower notch.

Slowing:

1. Slack bunch braking method can be used to slow down.
2. For loaded train automatic brake can be used to a higher degree than for an empty train.

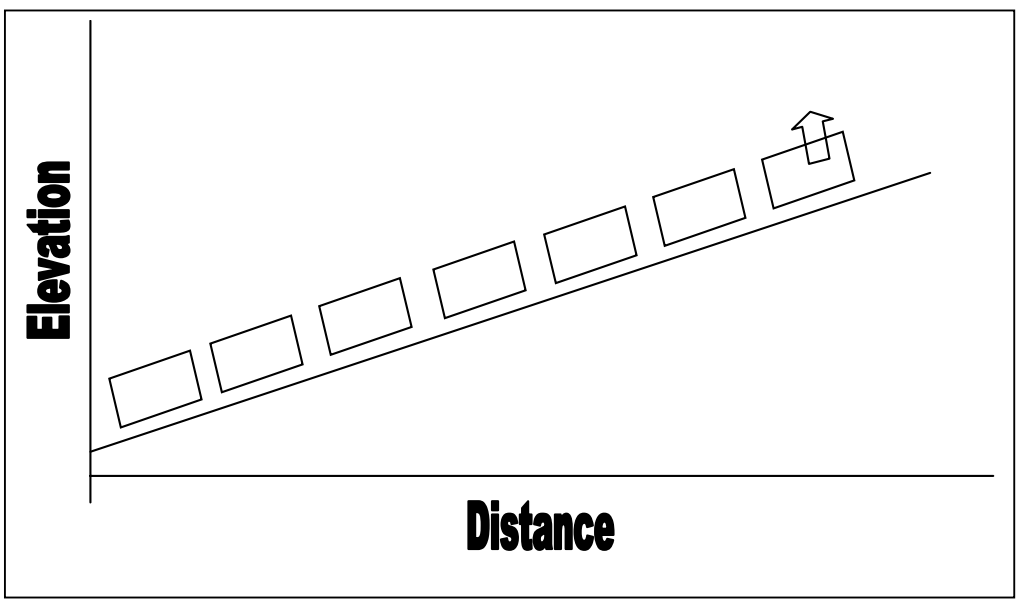
Stopping:

1. Use slack bunch braking method

Apply independent brake, after the train comes to a dead stop

HEAVY ASCENDING GRADE

General: Grade of more than 1 in 100 are termed as "Heavy ascending grade". Sudden notching up of may result in excess draw bar pull.



Starting:

1. Fully release the train brakes.
2. Advance throttle sufficiently to hold the train
3. Release the independent brake very slowly.
4. As the train starts moving, notch up duly watching the load meter.
5. If the wheel slips, reduce one or two notch position and apply sand.
6. Once the wheel slip stops, reapply power smoothing.
7. If the train does not move, reduce the throttle sufficiently to hold the train and apply independent brake. Then investigate the reason for not moving.

Accelerating:

1. Advance throttle to higher notch duly observing load meter.
2. Too fast notching up will result in high draw bar pull.

Negotiating:

1. Maintain free running in the slack stretched condition.
2. Make notch change slowly.
3. Do not change notch frequently.

Slowing:

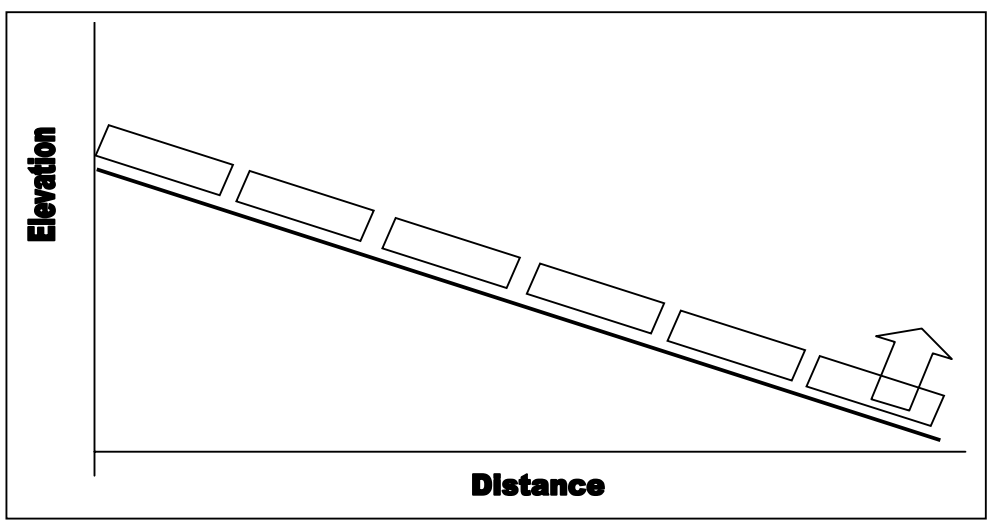
1. Slowly reduce throttle.
2. Allow sufficient time between notch positions to keep the slack stretched.
3. Control the train speed only by reducing throttle.
4. Do not apply automatic brake except in emergency.

Stopping:

1. Reduce the throttle slowly.
2. Allow the train to stall in one or two notch position.
3. Apply independent brake.
4. If automatic brake is applied, create the vacuum (or) brake pipe pressure to initial level just before the train comes to dead stop.
5. As soon as the train stops, apply independent brake to avoid roll back.

HEAVY DESCENDING GRADE

General: Grades of more than 1 in 100 is termed as heavy descending grade. Train should be kept and controlled be slack bunch method. Load and speed of the train should be carefully considered to maintain the speed.



Starting:

1. For loaded train move the selector handle to big 'B' or 'D' and then release the independent brake slowly.
2. For empty train, release the independent brake slowly and then apply dynamic brake gradually.
3. As the train starts moving, apply both dynamic and automatic brake to the required extent.

Accelerating:

1. Allow the train to accelerate by suitably releasing the automatic brake and dynamic brake.
2. Slack bunch should be maintained to avoid run out.

Negotiating:

1. Allow free run in dynamic brake mode operation to maintain the slack bunch.
2. Supplementary the automatic brake application with dynamic brake is maintained the speed.

Slowing:

1. Slack bunch braking method is to be used to slow down.
2. Cyclic application of automatic brake is required to keep the train under control.

Stopping:

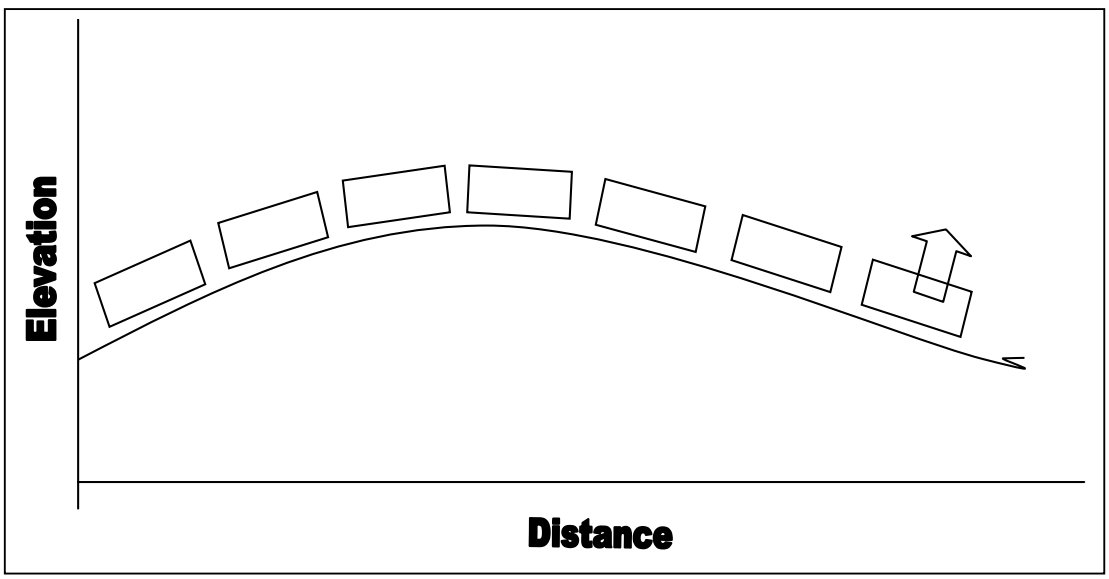
1. Use slack bunch and cyclic braking method.
2. Do not allow vacuum (or) brake pipe pressure to build up to initial level, before the train comes to dead stop.
3. However, allow the vacuum or brake pipe pressure in the raising trend, when the train comes to dead stop.

Cyclic Braking:

Cyclic Braking is used to maintain train speed by alternatively applying and releasing train brake. The application of brake should be sufficient to control the train speed with subsequent release for adequate changing of brake system.

CRESTING GRADE

General: Grades having long ascending grade followed be long descending grade is termed as Cresting Grade. Proper train handling at the peak is very important. Slack should be stretched to reduce the sudden change in draw bar forces.



Starting:

1. Fully release train brake.
2. Slowly release the independent brake to stretch the slack.
3. Open one (or) two notches gradually to make move.
4. Gradually open throttle, keeping stretch.

Accelerating:

1. As the head end of the train crest the grade, the weight of the locomotive and those vehicles, which crested, had to the tractive effort of the locomotive.
2. The weight and resistance of the rear portion appose the sum of these two effects, which is still in ascending gradient.
3. Due to this, draw bar pull is increased to exceed coupler strength at the top of the grade.
4. The throttle should be adjusted gradually to avoid excessive draw bar pull.
5. When the rear end of the train passes over the crest, the tendency for slack to run in should also be adjusted by throttle.

Negotiating:

1. Employing throttle only.
    - As loco crest the summit – reduce throttle gradually.
    - Further reduce throttle as the remaining portion of the train passes over crest.

2. Employing throttle and train brakes.
    - Reduce throttle gradually, as the loco with few vehicles starts descending.
    - Apply minimum reduction of train brake.
    - Make further application of train brake to maintain speed.
3. Employing dynamic brake only.
    - Reduce throttle gradually, as the loco with few vehicles starts descending.
    - Move the selector handle to braking mode.
    - Increase the braking effort gradually to maintain the speed.
4. Employing dynamic brake and train brake.
    - Reduce throttle gradually; as the loco with few vehicles starts descending.
    - Apply train brakes to minimum reduction.
    - Apply dynamic brake gradually.
    - Increase the dynamic brake effort and train brake effort as necessary to maintain the speed.

Slowing:

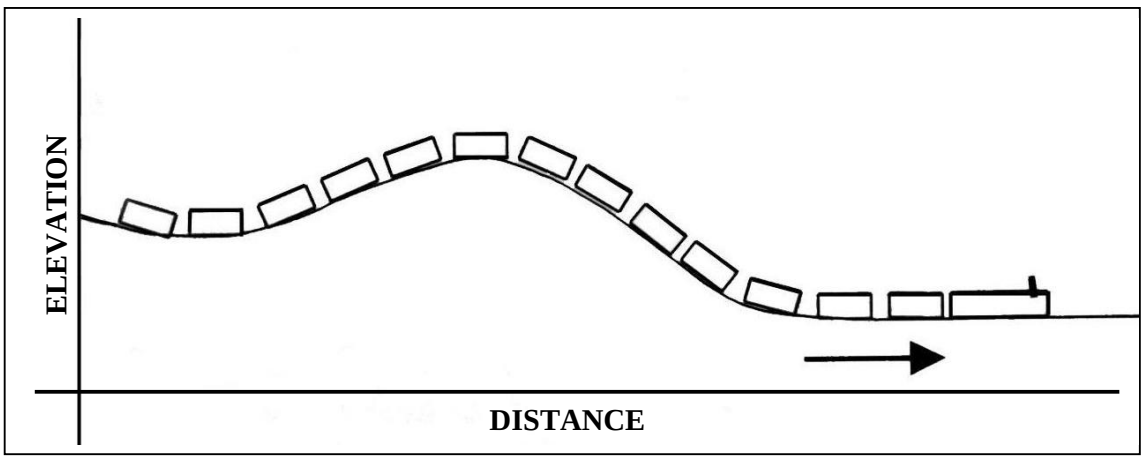
1. For train approaching cresting grade.
    - Reduce the throttle gradually, as the loco is in the ascending grade.
    - Allow sufficient time between notches to avoid severe bunching of slack.
2. When majority of train has crested the grade.
    - Use dynamic brake with train brake to slow down.
    - Keep the run-in under control by suitably applying train brake.

Stopping:

1. Employing train brake only.
    - Close the throttle gradually.
    - Apply train brake to minimum reduction.
    - Increase train brake to stop the train.
    - NOTE: Coupler force at the crest will be more, when the considerable length of train is in ascending grade.
2. Employing dynamic brake and train brake.
    - Use the train brake as stated above, with dynamic brake.

HUMP TERRITORY

General: A rapid increase in grade followed by a rapid decrease in grade is termed as 'Hump Territory'. The slack condition with in the train will change due to change in speed of vehicles with in the train.



Starting:

1. Release train brake fully.
2. Keeping the slack condition in mind, open throttle to first notch and then release independent brake very slowly.
3. As the train starts moving, increase throttle notch by notch duly considering the draw bar pull.

Accelerating:

1. Gradually increase the throttle duly considering the slack with in the train.
2. Sudden increase of throttle may result in parting.

Negotiating:

1. As the loco starts up the hump, increase the throttle to avoid slack bunching.
2. As the loco passes the hump, reduce throttle to reduce slack stretch.
3. As the rear portion of the train starts down the descending side of hump, slack will tend to run-in and then followed by a run-out at the bottom of the hump.
4. Higher notch as practicable to be maintained to reduce run-in.
5. Lower notch as practicable to be maintained to reduce run-out.

Slowing:

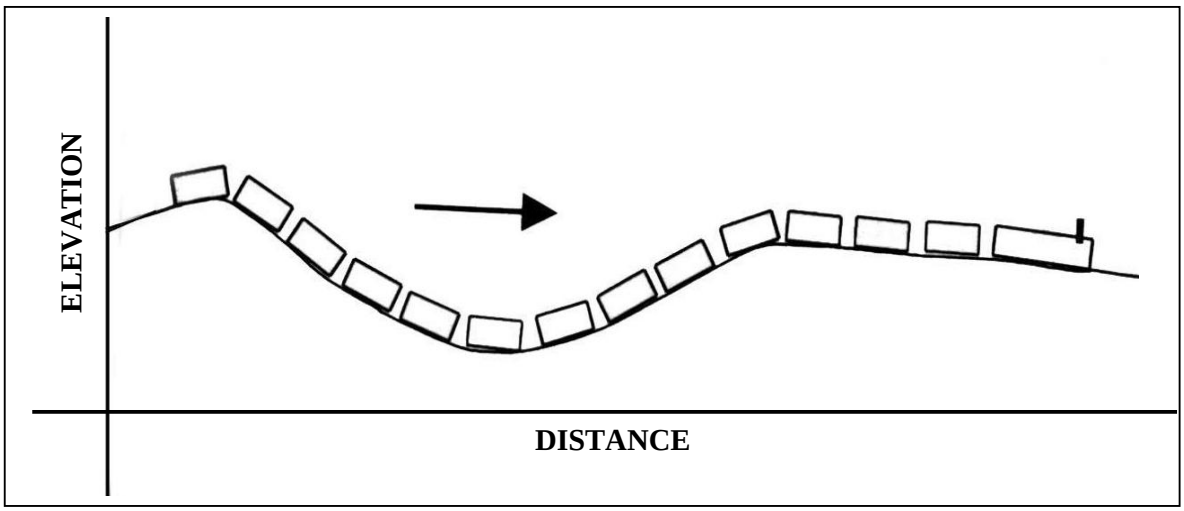
1. When approaching a hump, with throttle in power mode - using train brake slack stretched slow down may be used.
2. When approaching a hump with dynamic brake mode – using dynamic brake and train brake, slack bunch slow down may be used.

Stopping:

Slack stretched method of braking is normally advisable for stopping to avoid harsh bunching of slack.

SAG (OR) DIP TERRIRTORY

General: Descending grade followed by an ascending grade is termed as 'Sag' (or) 'Dip Territory'. Train operating through a sag has a tendency for the head and to decelerate when entering a level or ascending grade, while the portion of the train is still on the descending grade resulting in run-in of slack.



Starting:

1. Release train brake fully.
2. Keep the loco speed slow until the entire train starts moving.

Accelerating:

1. Open throttle gradually notch by notch.
2. Sudden notching up will result in parting.

Negotiating:

1. Reduce the speed when approaching the sag, use train brake if required.
2. Reduce the throttle when head portion descends into the sag.
3. Just before the head portion, reaches the ascending grade advance the throttle.
4. Continue to advance the throttle until the rear portion approaches the bottom of the sag. This will prevent heavy slack run-in from the rear of the train.
5. Reduce throttle sufficiently as the rear portion starts damping up the ascending grade to permit slack to adjust.

Slowing:

1. When approaching sag with power mode with train brake, slack stretched slow down may be used.
2. When approaching sag with dynamic brake mode using dynamic brake and train brake, slack bunch slow down may be used.

Stopping:

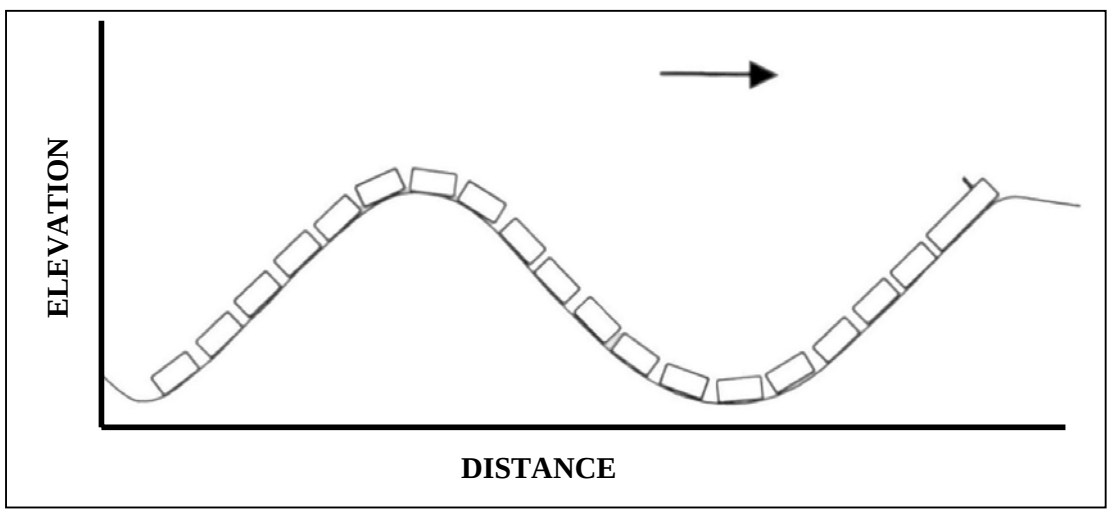
Slack adjust method of braking is normally advisable for stopping to avoid harsh bunching of slack.

UNDULATING GRADE

General: A track profile with grade changing so often that an average train passing over the track has some vehicles on alternative ascending and descending grades. Train slack is constantly changing and vehicles on descending grade tend to run-in and those on ascending grade tends to run-out.

Train handling in this type of territory depends on the following:

1. Train make-up.
2. Train speed.
3. Train length.
4. Train load.
5. Train features.



Starting:

1. Head end of train on descending grade.
    - Release independent brake slowly.
    - After the slack is stretched, open first notch to move.
    - If the train moves rapidly, while releasing independent brake, apply train brake to control the speed.

2. Head end of the train on ascending grade.
    - Open throttle to first notch.
    - Release the independent brake slowly
    - Advance throttle as the slack is stretched.

Accelerating:

1. Advance throttle very slowly than normal condition.
2. As the slack cannot be stretched – throttle should be very slowly adjusted.

Negotiating:

1. Employing throttle manipulation.
    - Maintain Train speed as constant as possible.
    - Do not change the throttle position frequently as this will increase the in-train forces.
2. Employing dynamic brake.
    - Maintain train speed by slowly adjusting the selector handle.
    - Do not change the selector position rapidly, as this will increse the in-train forces

Slowing:

1. Employing throttle manipulation.
    - Use lower throttle position on ascending portion of grade.

2. Employing throttle and train brake.
    - Only minimum reduction of train brake is advisable duly controlling the train reducing throttle well in advance.

3. Employing dynamic brake and train brake.
    - In conjunction with dynamic brake, train brake can also be used to slow down.
    - Dynamic brake should be carefully adjusted to avoid severe in-train forces.

Stopping:

1. Use slack bunch braking method to stop.
2. Train brake may be applied to minimum reduction position before applying train brake further.
3. Dynamic brake and train brake has to be adjusted to reduce in-train forces.

CURVATURE:

Special care must be observed in negotiating curves in excess or two degree, especially those of four degree and more.

Starting In Curve:

- Notching up should be done carefully – minimum required to start the train.
- This is essential to minimize draft forces which can generate excessive inward lateral forces.
- Rapid notching can result in "string lining" of curve, which can shift the track, turn the rail or even cause a derailment.

Running Over Curvature:

- ❖ Always avoid throttle manipulation, dynamic braking or air brake application near the beginning, within, or near the end of any cock.
- ❖ Speed should normally to be reduced to the prescribed speed or lower, prior to entering the curve.

Stopping in curve:

- ❖ Use dynamic brake in addition to A-9 brake application.
- ❖ Total braking effort to dynamic and air brake should be kept at the lowest desirable level when slowing or stopping in curve territory.

GHAT SECTION

General: The rule gradient of 1 in 50 or steeper are considered as 'Ghat Section'.

Note: Ensure,

- 100% / 90% of brake power on formation.
- Dynamic brake in working order.
- Speedometer in working order.
- Sand gear in working order.

Starting:

a. Ascending:

- ➢ Ensure train brakes are fully released.

Advance the throttle sufficient to hold the train.

b. Descending:

- ➢ Ensure the brake power continuity on formation on formation.
- ➢ Apply dynamic brake and release independent brake so as to start the train in slack bunched condition.
- ➢ As the train starts rolling, control the train in bunched mode by the manipulation of dynamic brake.

Note:

- ✓ Ensure the brake power of train at the first opportunity.
- ✓ If auto-emergency brakes(AEB) provided in loco, ensure its function for the set speed in the section.

Negotiating:

a. Ascending:

- Maintain free running in slack stretched condition.
- Maintain the section speed and do not change the notch frequently to avoid
  - Heavy in train forces, and
  - Wheel slip/stalling.

b. Descending:

- Keep on control over the train running within the speed limits by the maximum efforts of dynamic brake application along with automatic brake application, if necessary.
- Train speed should be controlled/reduced by cyclic brake application.

Stopping:

a. Ascending:

- By reducing the throttle to lower notches so as to stop & hold the train in a stretched condition.
- Fully apply the independent brake and formation and formation brake to minimum reduction to avoid roll back.
- Bring the throttle to idle.

b. Descending:

- Along with dynamic brake application apply train brakes to bring train to dead stop.
- Apply independent brakes fully.
- If necessary apply train brakes to minimum reduction to avoid pushing.

Special Note:

To avoid rolling back of the train at the time of engine failure (loco shut down) immediately apply train brakes fully and take precautions as per the instructions in force.

BANKER OPERATION

General: There are two types of banker working,

1. Banker loco is attached next to the train engine. This type of working is also called 'Double Head Working' or 'Assisting Loco Working'.
2. Banker loco is attached next to the brake van.

In both types of working, the banker loco should be isolated from creating vacuum/brake pipe pressure. The banker Driver should keenly watch the vacuum/brake pipe pressure gauge, load meter and speedometer for effective banking. Walkie-talkie may be used liberally to get better co-ordination between the leading and banker Drivers.

Starting:

1. When the train is ready to start in all respects, the leading Driver should blow the starting whistle and communicate through walkie-talkie.
2. The banker Driver should first start the train duly considering the train conditions.

Accelerating:

Banker Driver can open the throttle notch by notch duly watching the gauges and speedometer.

Negotiating:

1. According to the terrain condition, the banker Driver can assist the leading Driver in motoring mode of operation.
2. In case of double head working, the assisting Driver can also use dynamic brake to maintain the speed.
3. In case of banker attached next to the brake van, the banker Driver should not use the dynamic brake.

Slowing:

1. The leading Driver should give indication to the banker Driver by sharply applying train brake well in time.
2. In double head working, the assisting Driver, can use dynamic brake to slow down in descending grades.
3. In banker working from the rear of the brake van, the banker Driver should suitably reduce throttle to slow down.
4. In both double head and rear brake van banking the leading Driver alone should have the control over charging and discharging vacuum/brake pipe pressure.

Stopping:

1. The leading Driver should control the train speed well in advance.
2. In double head working, the assisting Driver can keep the dynamic brake 'ON' till the train stops in slack bunch braking.
3. In rear brake van banking, the banker Driver can reduce throttle suitably duly avoiding stalling and roll back.
4. In double head working, the assisting Driver can apply independent brake to hold the train in descending grade.
5. in rear brake van banking, the banker Driver should not apply independent brake. However in case of roll brake, he can open the emergency brake valve to stop the train.

MU OPERATION

Preparation:

- Crank and test the loco individually.
- Couple the loco couplings and the followings.
  - Brake pipe,
  - Feed pipe,
  - Brake cylinder equalizer,
  - MR equalizer,
  - Vacuum train pipe and
  - MU jumper cable.
- Keep the COC, breakers and switches as like in single head in the leading loco.
- Do the following changes in the rear loco from the existing single loco set up.
  - Keep MU2B 'dead/trial'
  - Keep A-9 COC closed in both the control stands
  - Keep additional C2 relay valve COC (3/4 " COC) in closed position.
  - Keep MCB, MFPB and GF in 'off' position in both control stands.
  - Remove A-9/SA-9 handles duly keeping them in release also remove Reversor Handle.

- Do the following tests from leading loco, and ensure that rear loco also responds to the tests.
  - Engine RPM test
  - A-9 and D1 emergency brake valve test
  - Loco brake power test
  - Dynamic brake test
  - Load meter responds the forward and reverse direction test
  - Dog pulling test

Working:

- Create required level of vacuum/brake pipe pressure before starting the train.
- Do not go beyond third notch while starting the train.
- Allow sufficient pause between notches.
- Use dynamic brake at the maximum extent.
- Use the power shutter switch, if provided.
- Shut down the rear loco, if the train is less loaded.
- In case of GE traction motor provided loco in the lead and the BHEL traction motor in the rear, treat the load meter reading of 980 amps as the restricted zone.
- In case, if any trouble in the rear loco, only bell or buzzer (as the case may be) indication will come in the lead loco.
- On each stopping, the rear loco should be checked for the battery charging, CCEM working, brass spindle projecting out and for any other abnormality.

TRAIN PARTING DUE TO IMPROPER TRAIN HANDLING

General: The train parting is an unforeseen dividing of a train into two or more portions while the train is on run or just on the move.

Train parting happens mainly due to draw bar components. They break at the weakest section, especially under shock loads. Though sufficient amount of factor of safety is provided to draw bar components to with stand normal working conditions. However, they may fail due to spontaneous and momentary heavy forces i.e., shock load acting on them under unusual operating conditions. Proper train handling techniques can reduce the shock loads to great extent. The different handling methods are discussed below.

While Starting:

1. Ensure the authorized load on the train and coupling with hose connections.
2. Ensure that the train is free from brake binding. Also ensure the correct vacuum/BP level.
3. In case of CBC coupling, before starting push back the train for approximately half a wagon length to make the CBC logs to fall on its locking position.
4. While pushing back, do not allow rolling back.
5. Move the train forward; only after the rear movement of the train has stopped.
6. In case of screw coupling, release the independent brake after opening the throttle to first notch.
7. During starting, if load meter shoots up rapidly, do not advance the throttle further and try for another start.

8. Do not close the throttle to idle suddenly before restarting to the another start.
9. Apply independent brake with throttle with throttle in first notch position and then close the throttle to idle.
10. Before the train starts moving do not open more than four notches.
11. Do not allow more than 650 amps starting current in MU locos and double head working.
12. While starting from curves and turn outs apply power smoothly.

While Accelerating:

1. While notching up, observe the load meter for sudden changes.
2. Allow the forward and reverse at the lower notch possible.

Negotiating:

While coasting run, keep the train in either slack stretch or slack bunched mode.

Slowing:

1. Close the throttle gradually.
2. Apply dynamic brake and train brakes smoothly.
3. Whenever it is required to accelerate after slowing down ensure full creation of vacuum/BP level.

Stopping:

1. Do not apply independent brake before train comes to dead stop.
2. Ensure raising trend vacuum/BP while stopping

FIRE FIGHTING

FIRE: Active rapid burning and oxidation process accompanied by heat, light and poisonous gases /smoke/carbon dioxide gas due to combustion is called fire.

CAUSES OF FIRE :

- LAPSE IN SAFETY ACTS: Several acts of negligence, carelessness usually accumulate and increase fire hazard e.g., lack of house keeping, leakages neglected, poor maintenance etc.,
- HUMAN ERROR/ NEGLIGENCE: Lack of awareness and lack of training.
- ELECTRIC ARCS, FLASHOVERS, SPARKS: Loose connections, flashovers, electric arcs.
- ELECTRIC SHORT CIRCUITS: Any short circuit in electrical equipment will cause fire.
- OVER LOAD: Over loading of equipment will cause over heating and fire may takes place.
- FAILURE OF COOLING SYSTEM.
- LIGHTENING STROKES.
- OPEN FLAMES.
- EXHAUST GAS LEAKAGES.
- FUEL AND LUBE OIL LEAKAGES.

Brief Note about fire extinguisher:

1. The DCP type fire extinguisher which are using in our Diesel locomotives are having capacity of 5 kg.
2. It is one of the safety item in the drivers cabin.
3. Normally two numbers of fire extinguishers are available in the locomotive while working a train.
4. While TOC of the locomotive crew should ensure that the safety clip provided on the strike knob and also ensure the date of expiry.
5. When it is operated , the dry chemical powder will come for a period of 15 to 20 seconds without stop.
   Once it is operated , it will not stop till the complete powder exhaust from the barrel.

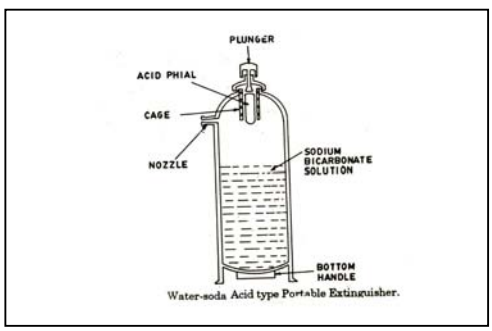
TYPES OF FIRE EXTINGUISHERS & USE ON DIFFERENT KINDS OF FIRES

I. Soda Acid type: On ordinary fires which leaves ashes after burning. Water also can be used on ordinary fires.

How to use:

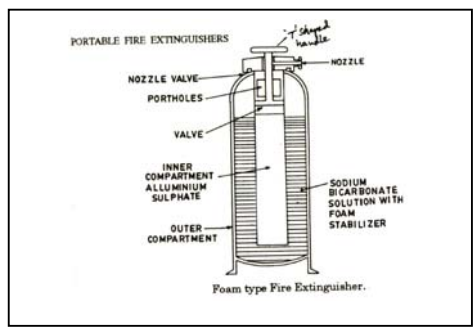
1. Remove the safety clip
2. Strike on to the plunger knob on top of the fire extinguisher,
3. turn down the fire extinguisher
4. direct the jet onto the fire.

If the nozzle of the above fire extinguisher is horizontal, the fire extinguisher is to be turned down before use and if the nozzle is upward the fire extinguisher need not be turned down before use.



Water-soda Acid type Portable Extinguisher.

I



Foam type Fire Extinguisher.

II

II. Foam type: On fires of oils only.

DCP type fire extinguisher can also be used when foam type is not available in time.

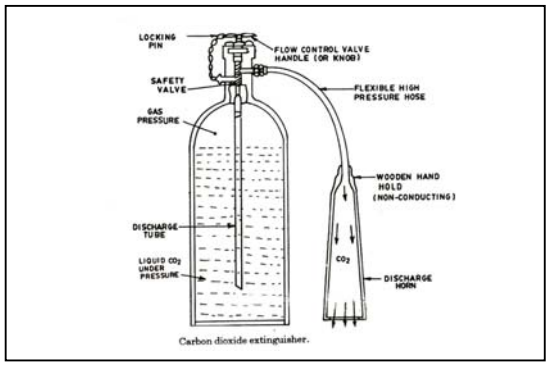
How to use:

1. Lift the T shaped handle, on top of the fire extinguisher
2. turn the handle to 90 Deg. Horizontal.
3. Shake the fire extinguisher,
4. turn down and then direct the jet to the edge of the container.

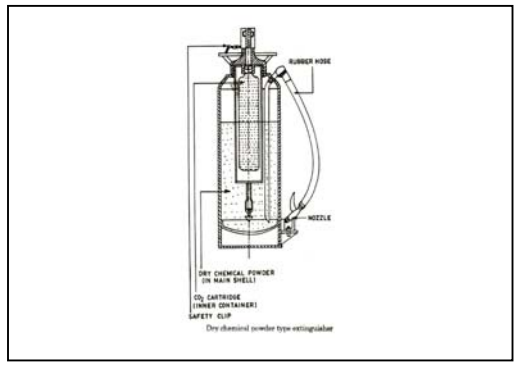
III. Dry Powder (DCP) type: For use on all kinds of fires inclusive of fires on electrical and chemicals etc.,

How to use:

1. Keep fire extinguisher upright.
2. Unwind discharge tube.
3. Hold nozzle in hand.
4. Remove safety clip & strike knob.
5. Press the discharge nozzle handle
6. Direct stream at base of fire.



III



IV

IV. Carbon -Di-oxide (CO_2)type: For use on fires of electrical , chemical and some chemical fires.

How to use:

1. Screw handle to be turned to slack side
2. direct the jet through horn provided on to the fire.

V. Halon type: For use on electrical, electronic and important equipments. At present these are provided in computer rooms, buildings and AC carriages.

How to use:

1. Remove the safety pin,
2. squeeze the operating lever
3. aim at the base of the fire.

Ventilate the area after using this type of fire extinguisher.

NOTE: Do not use Water on oils and electrical fires.

How to use DCP fire extinguisher:

1. Keep fire extinguisher up right .
2. Unwind discharge tube.
3. Hold nozzle in hand.
4. Remove safety clip and press strike knob.
5. Press the discharge nozzle handle.
6. Direct stream at base of fire.

NOTE: Observe wind direction.

WHILE USING WALKIE TALKIE SETS:

DO's:

- DRIVER - USE IT TO INFORM THE GUARD FOR PROTECTION OF THE TRAIN.
- GUARD - USE IT TO COMMUNICATE TO THE DRIVER THE LEVEL OF AIR PRESSURE / VACUUM IN THE BRAKE VAN WHEN EVER ENGINE IS CHANGED.
- GUARD - USE IT TO COMMUNICATE TO THE DRIVER OF SUPERFAST EXPRESS TRAINS AFTER CLEARING THE SPEED RESTRICTION ZONE AND ALSO AFTER CLEARING LOOP LINES.
- DRIVER & GUARD – USE IT TO ASK STATION MASTER A RELIEF LOCO WHEN LOCO BECAME DISABLED.
- DRIVER & GUARD – USE IT TO TAKE PERMISSION FROM THE STATION MASTER TO PUSH BACK THE TRAIN WHEN GOODS TRAIN IS UNABLE TO HAUL THE LOAD.

Don't:

- USE IT AS AN ALTERNATIVE TO PHYSICAL EXCHANGE OF ALL RIGHT SIGNALS.
- USE IT AN ALTERNATIVE TO RETURN AUTHORITY TO PROCEED .
- USE IT AS AN ALTERNATIVE TO PASS A DEFECTIVE SIGNAL AT 'ON'.
- USE IT AS AN ALTERNATIVE TO COMMUNICATE THE ASPECT /POSTION OF THE SIGNAL TO DRIVER/ GUARD.

NOTE:

- SHOULD BE USED ONLY AS AN EMERGENCY COMMUNICATION.
- STATION MASTER /DRIVERS/GUARDS WILL CLEARLY MENTION THEIR IDENTITY WHILE COMMUNICATING AND ALSO CONFIRM THEIR IDENTITY OF THE SPEAKER AT THE OTHER END.
- USAGE OF WALKIE TALKIE SETS IN NO WAY ABSOLVE THE CONDITIONS REQUIRED TO BE SATISFIED FOR THE RECEPTION / DESPATCH OF TRAINS AS PER G&SR.
- IT SERVES AS A SUPPLEMENT FOR COMPLIANCE OF RULES AS PER G&SR.

Do's and don'ts for drivers

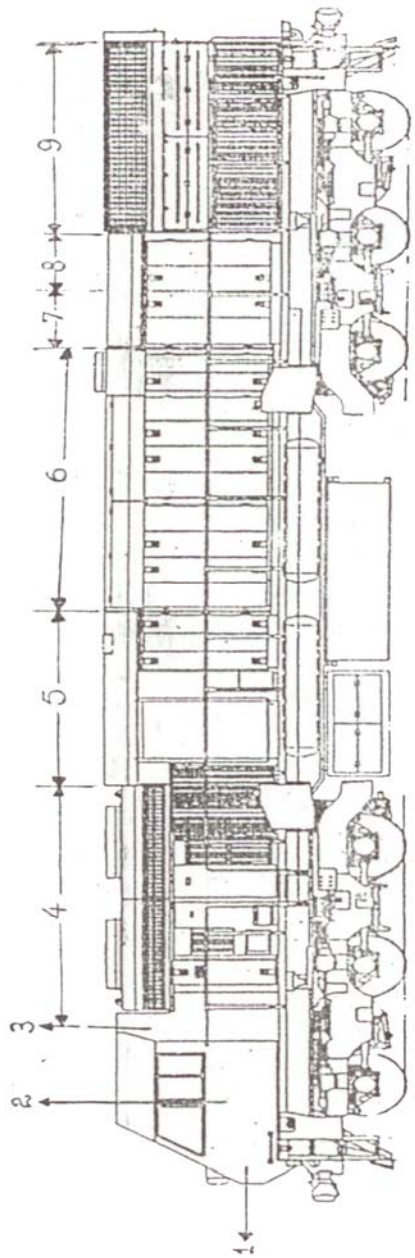
DO's

- TAKE SUFFICIENT REST BEFORE COMING TO DUTY,
- NOTE ALL CAUTION ORDERS AND OBSERVE THEM,
- CHECK THAT YOU HAVE RECEIVED CORRECT AUTHORITY TO PROCEED (ATP) BEFORE STARTING THE TRAIN,
- COLLECT BPC AND CHECK THE VALIDITY. CHECK FOR THE CORRECT AMOUNT OF VACUUM/AIR PRESSURE IN THE ENGINE,
- ENSURE CORRECT POSITIONS OF COCS IN LOCOS AS PER THE LOCO POSITION BEFORE WORKING FOR A TRAIN,
- CONDUCT 'FEEL TEST' TO KNOW THE BRAKE POWER OF THE TRAIN,
- FREQUENTLY LOOK BACK, ESPECIALLY ON A CURVE, TO ENSURE THAT YOUR TRAIN IS RUNNING SAFELY,
- ENSURE CORRECT/SUFFICIENT OIL LEVELS AT SPECIFIED POINTS IN LOCO TO AVOID FAILURE OF LOCO IN MID-SECTION,
- WATCH FOR ANY UNUSUAL SOUND FROM ENGINE, EXPRESSOR, RADIATOR ROOM AND UNDER TRUCK,
- HAVE AN EYE ON METERS AND GAUGES DURING RUN FOR CORRECT READINGS
- ALWAYS HAVE THE REFERENCES FOR RULES/AUTHORITIES AND LATEST INSTRUCTIONS,
- APPLY DYNAMIC BRAKE LIBERALLY TO OBTAIN
- APPLY ALL POSSIBLE BRAKES ON LOCO/TRAIN IF LOCO/TRAIN STOPPED IN MID-SECTION,
- PUT ON FLASHER LIGHTS WHEN TRAIN ENGINE FAILED IN MID-SECTION,
- ENSURE A DEAD LOCO ATTACHMENT IS DONE AT THE REAR OF WORKING LOCO,
- ENSURE AIR CONTINUITY ON AIR BRAKE FORMATION BEFORE STARTING TRAIN
- ENSURE ALL EMERGENCY SWITCHES/BREAKERS IN OFF POSITION UNDER NORMAL WORKING CONDITION,
- RECORD THE TROUBLES YOU HAVE EXPERIENCED REGARDING LOCO ON RUN IN LOG BOOK IN ADDITION TO CONTACTING PRC/SHED,
- PREVENT JERKS ON FORMATION WITH BETTER OPERATIONAL TECHNIQUES.

Don't:

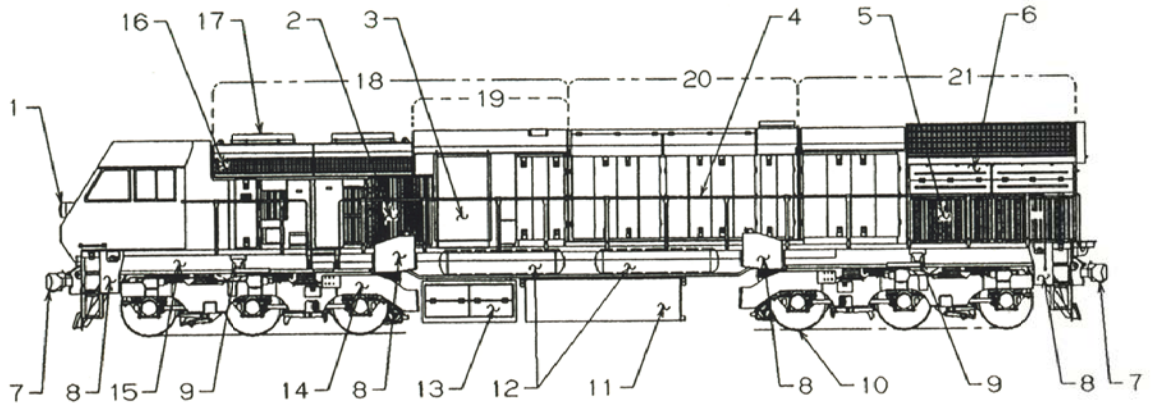
- CONSUME ALCOHOLIC DRINKS BEFORE COMING FOR DUTY OR WHILE ON DUTY,
- START YOUR TRAIN BEFORE BUILDING UP OF REQUIRED PRESSURES AND COMPLETE RELEASING OF BRAKES ON TRAIN,
- LEAVE THE LOCO UNMANNED,
- NEGLECT LOOSE/HANGING PARTS IN LOCO,
- MOVE DEAD LOCO WITHOUT ATTACHING REQUIRED PIPES TO THE WORKING LOCO,
- DETACH A LOCO FROM THE FORMATION IN BLOCK SECTION WITHOUT SECURING FORMATION,
- ALLOW / KEEP INFLAMMABLE ARTICLES IN DRIVER'S CAB,
- APPLY SA9 BRAKE VALVE WHILE TRAIN IS ON RUN,
- ENTER INTO THE RADIATOR ROOM WHILE ENGINE IS IN RUN,
- EXCEED THE MAXIMUM PERMISSIBLE SPEED (MPS)
- NEGLECT LEAKAGES OF FUEL, LUBE, WATER AND AIR HOWEVER SMALL IT IS
- DO FAST NOTCHING UP,
- SHUT DOWN THE ENGINE WHEN BA SHOWING DISCHARGE,
- ENTER THE READINGS IN LOG BOOK WITHOUT OBSERVING METERS AND GAUGES,
- BYE-PASS ANY SAFETY DEVICE,
- SWITCH ON EMERGENCY SWITCHES/BREAKERS UNNECESSARILY
- UTILIZE MANUAL TRANSITION WHEN AUTO TRANSITION IS IN NORMAL WORKING CONDITION.

LOCOMOTIVE COMPARTMENTS.



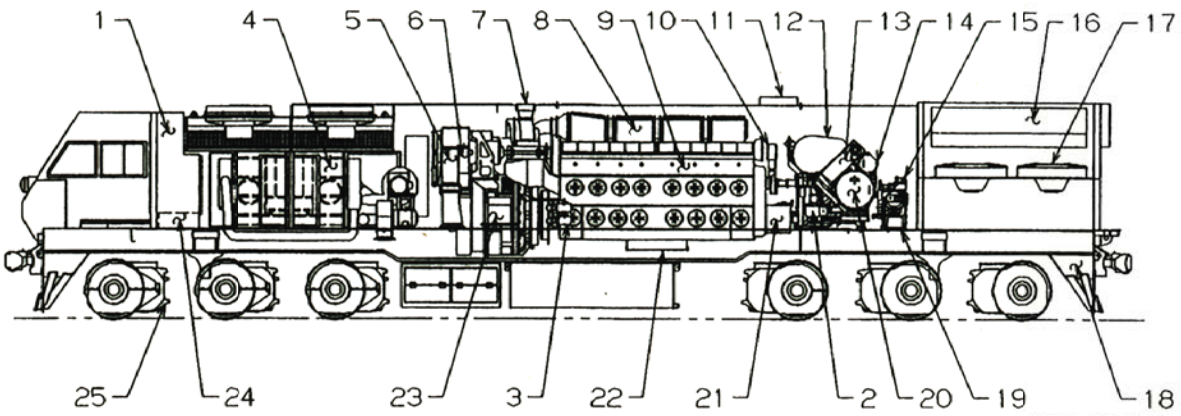
1.AIR BRAKE RACK
2.DRIVERS CAB
3.ELECTRICAL CONTROL CABINET
4.TCC1 & TCC2 COMPARTMENT
5. TRACTION GENERATOR COMPARTMENT
6. ENGINE ROOM
7. ENGINE ACCESSORIES ROOM
8. COMPRESSOR ROOM
9. RADIATOR ROOM

WDG4 LOCOMOTIVE - SIDE VIEW



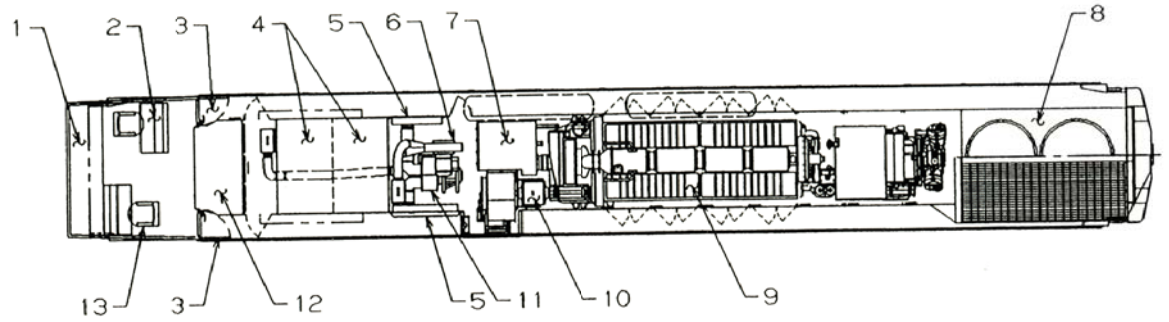
1.HEAD LIGHT
2.INERTIAL FILTER AIR INLET
3.STARTING FUSE AND BATTERY KNIFE SWITCH BOX
4.HANDRAILS
5.COOLING SYSTEM AIR INLET
6.RADIATOR AND FAN ACCESS
7.COUPLER "E/F" TYPE
8.SAND BOX
9.JACKING PADS (QTY.4)
10.WHEELS (QTY.12)
11.FUEL TANK
12.COMPRESSED AIR SYSTEM MAIN RESERVOIRS
13.BATTERY BOX
14.TRUCKS (QTY.2) 3 AXLE 3 MOTOR HTSC TYPE
15.UNDERFRAME
16.DYNAMIC BRAKE GRIDS
17. DYNAMIC BRAKE FANS (QTY.2)
18.TCC AND MAIN GENERATOR COMPARTMENT
19.MAIN GENERATOR COMPARTMENT
20.ENGINE ROOM AND ACCESSORIES COMPARTMENT
21.COMPRESSOR AND RADIATOR COMPARTMENT

WDG4 LOCOMOTIVE - INTERNAL VIEW



1. ELECTRICAL CONTROL COMPARTMENT
2. FUEL PUMP MOTOR
3. ENGINE STARTING MOTORS (QTY.2)
4. TRACTION CONTROL CABINET
5. TRACTION MOTOR COOLING AIR BLOWER
6. MAIN GENERATOR\ COMPANION ALTERNATOR BLOWER
7. ENGINE EXHAUST STACK
8. ENGINE EXHAUST MANIFOLD
9. 16 - 710 G3B DIESEL ENGINE
10. GOVERNOR
11. ENGINE ROOM VENT
13. LUBE OIL COOLER
14. PRIMARY FUEL FILTER
15. AIR COMPRESSOR
16. RADIATORS
17. AC RADIATOR COOLING FANS (QTY.2)
18. DRAFT GEAR
19. AIR COMPRESSOR AIR FILTER
20. LUBE OIL FILTER TANK
21. LUBE OIL STRAINER
22. LUBE OIL SUMP
23. MAIN GENERATOR/ COMPANION ALTERNATOR
24. ELECTRICAL CONTROL CABINET AIR FILTER BOX
25. TRACTION MOTORS (QTY.6)

WDG4 LOCOMOTIVE - TOP VIEW



1.AIR BRAKE RACK

2.ENGINEERS CONTROL CONSOLE

3.CAB DOOR

4.TRACTION CONTROL CABINETS

5. INERTIAL AIR FILTER

6.TCC ELECTRONICS BLOWER

7.ENGINE AIR FILTER

8. RADIATORS

9. ENGINE

10. AC AUXILIARY GENERATOR

11.INERTIAL FILTER
DUST BIN BLOWER AND MOTOR

12. ELECTRICAL CONTROL CABINET

13.CAB SEAT

I. NOSE COMPARTMENT : CCB(Computer Controlled Brake) Air Brake Equipment Panel, Dead Engine COC, Goods/Passenger Handle.

II. DRIVERS CAB :

Control Stands (consoles) : 2 Nos

Each Control Stand is divided into 3 panels.

A) Control stand top surface: This houses on Top of Control Stand.

B) **Front Instrumental panel** : It is located on top vertical section of the control stand.

C) **Left side control panel** : This panel is provided left side of the control stand.



Figure 2-2. No.2 Control Console, Typical
(Instrument Panel and Desk Top portions)

A) CONTROL STAND TOP SURFACE:

i. Locomotive Controller

1) Reverser Handle
2) Throttle/Dynamic Brake Handle

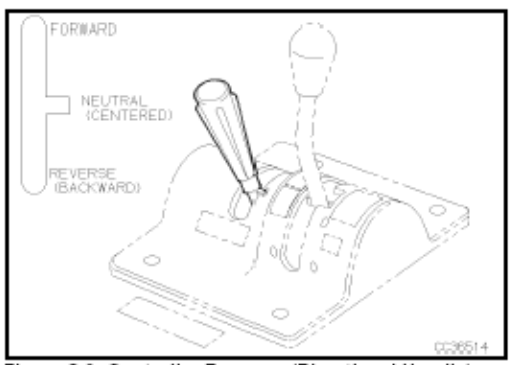


Figure 2-9. Controller Reverser (Directional Handle)

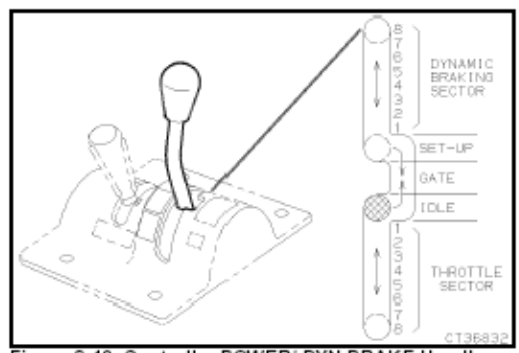


Figure 2-10. Controller POWER/ DYN BRAKE Handle

ii. Cab Control Unit or Brake Controller (CCU)

1) Automatic Brake Handle with 5 positions.
   a) Release (spring loaded for over charging.)
   b) Run
   c) Minimum Reduction
   d) Full Service
   e) Emergency



Figure 2-11. Air Brakes Cab Control Unit (CCU), Typical

2) Independent Brake Handle have following Positions
   a) Release
   b) Application
   c) Bail off (Quick Release) by Spring Loaded ring in the handle itself.
3) Air Brake Lead/ Trail Setup Switch (like MU2B) With 4 positions.
   a) HLPR: Used during Banking loco working control stand.
   b) Trail : In Leading Loco non-working Control Stand and also for Trailing loco both the control stands.
   c) Lead : Used with loco in lead or controlling .
   d) Test: In working control stand used during brake pipe leakage-testing and also during attaching of locomotive on formation.

<u>When Lead/Trail switch is set</u>:

In HLPR position	:	Automatic Brake controller will function during emergency Position only and independent brakes will have normal function.
In Trail position	:	Both Automatic and independent Brake functions will be isolated except Emergency of automatic brake functions.
In Lead position	:	Both Automatic and independent brakes will have normal function.
In Test position	:	Independent brake will function and also automatic brake controller will function during emergency position only.

iii) Reset (Alertness Control)

Push button switch & Alerter Light	:	It senses Driver's Alertness resulting in penalty brake application.

iv) Manual Sanding Switch (Yellow Push Button)

v) Horn Push Button Switches	:	Two
vi) Head Light Switches	:	Front and Rear.
vii) Clip Board	:	To keep caution order, Fuel Balance Sheet BPC, etc.



Figure 2-14. MU ENGINE STOP Switch (top), and Control & Operating Switch Panel with DYN BRAKE CONT CB

viii) Control and Operating Switch Panel: On Long Hood Control Stand right side .

1) Engine Run Slide Switch.
2) Fuel Pump & Control Slide Switch.
3) GF Slide Switch
4) Dynamic Brake Control Circuit Breaker.
5) MU Push Button Switch

B) FRONT INSTRUMENTAL PANEL:

i) Wind shield Wiper Control Knobs two number in each control stand.

ii) Gauges provided on the control stand:

1)Duplex air pr. gauges in kg/cm square
   a) MR(Red) & Equalizing (White)pressures
   b) BP(White) & BC(Red) Pressures.

2) Air Flow indicator
3) Speedometer In KMPH
4) Tractive/Dynamic Brake Effort Meter in KN (Kilo new tons)

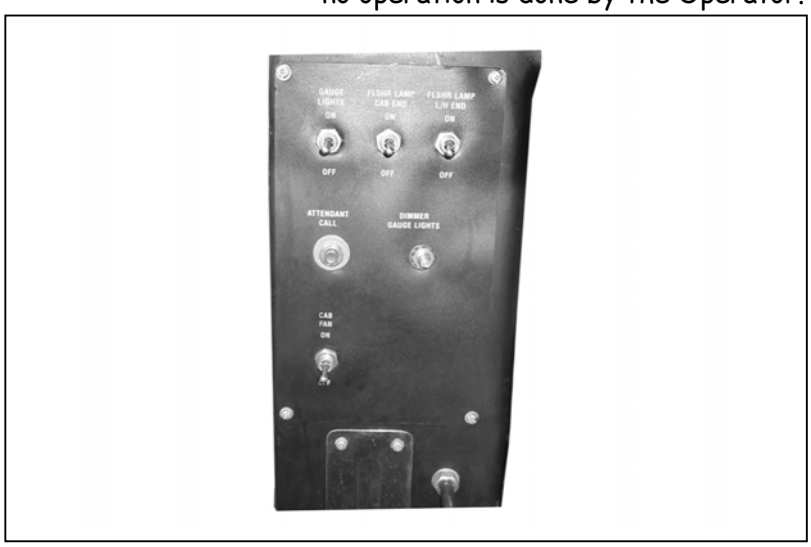


Figure 2-8. Indicating Lights Panel

iii) Indicating Light Panel : Each of the following indicator lights has the push to test feature which allows testing the light circuit alone.

1) In WDG4 Locos Tractive Effort Limit Light & In WDP4 Locos Blended Braking light (Yellow)
2) Sand Light. : (White)
3) Wheel Slip Light. : White)
4) Flasher Lamp Light : (Yellow)
5) PCS open light : (Red)
6) Brake warning light : (Yellow)

iv) Alerter light : A large Yellow indicator lights after 60 seconds if no operation is done by the Operator.



C) **<u>LEFT</u> <u>SIDE</u> <u>CONTROL</u> <u>PANEL</u> <u>:</u> It consists of**

i. Cab Fan Switch,
ii. Gauge light Switch,
iii. Cab light Switch (only in WDP4)
iv. Attendant call switch,
v. Flasher lamp Switch (SH & LH)
vi. Fireman Emergency Valve handle.

III. NO #1 ELECTRICAL CONTROL CABINET:

This includes the followings (Drivers Cab end)

Four operator accessible panels

A) Circuit Breaker Panel.
B) Circuit Breaker and Test Panel
C) EM 2000 Display panel.
D) Engine Control Panel.



Figure 2-15. No. 1 Electrical Control Cabinet (ECC1), Typical

<u>A)</u> <u>Circuit</u> <u>Breaker</u> <u>Panel</u>: Consists three types of breakers. Breakers in "White" labeled section are used as per the required condition. Breakers in "Black" labeled section of the panel must be "ON" before cranking. Breakers in "Zebra"

(Yellow labled)labeled section of the panel must be "ON" before Cranking,(after black labeled switching ON) during Shutting down switch OFF after TLPR OFF.

White labeled section Breakers : **(1st Line)**

1) LIGHTS breaker	:	Controls Locomotive Lights,
2) HDLTS breaker	:	Provides power and protection to HDLTS Circuit,
3) RADIO breaker	:	For Radio Communications,
4) EVENT RECORDER BREAKER	:	Provides power and protection to the E. R. circuit,
5) CAB FANS breaker	:	Provides power and protection to the C.F. circuit,
6) AIR DRYER breaker	:	Provides power and protection to the MR air filter dryer circuit
7) GOV BOOSTER PUMP BREAKER:		Provides power and to the Governor Booster Pump,(Only in 4)

Black labeled Section Breakers: **(2nd Line)**

1) AC CONTROL Breaker	:	Protects companion alternator output & including Traction Alternator excitation and G.R. hardware,
2) CONTROL Breaker	:	Sets up the fuel pump and control circuits before cranking through BKS and through AG when engine is running,
3) LOCAL CONTROL Breaker	:	Operates heavy duty switch gear, magnet valves, contactors, blowers and miscellaneous relays operated by locomotive battery/Auxiliary Generator.
4) DCL CONTROL Breaker	:	Protects DC Link transfer switch motor circuit,
5) FILTER BLOWER MTR BREAKER:		Protects Air Inertial filter blower motor circuit,
6) AC GTO #1 PWR SUPPLY BREAKER:		Protects GTO #1 power supply, DC supply input to TCC1 Inverter,
7) AC GTO #2 PWR SUPPLY BREAKER		Protects GTO #1 power supply, DC supply input to TCC2 Inverter,

Black labeled Section Breakers: **(3rd Line)**

1) AUX GEN FLD Breaker	:	Protects the Auxiliary Generator field circuit,
2) AUX. GEN. F.B. Breaker	:	Protects the Traction Alternator field firing control circuit (FCD)
3) FUEL PUMP Breaker	:	Protects the Fuel pump Motor circuit,
4) TCC1 COMPUTER Breaker	:	Provides power and protection to the TCC1 Computer,
5) TCC2 COMPUTER Breaker	:	Provides power and protection to the TCC2 Computer,

(Two Zebra striped Breakers) Yellow)

6) TURBO Breaker	:	Provides power and protection to the turbo lube oil pump motor.
7) COMPUTER CONTROL Breaker	:	Protects the locomotive control Computer power supply,

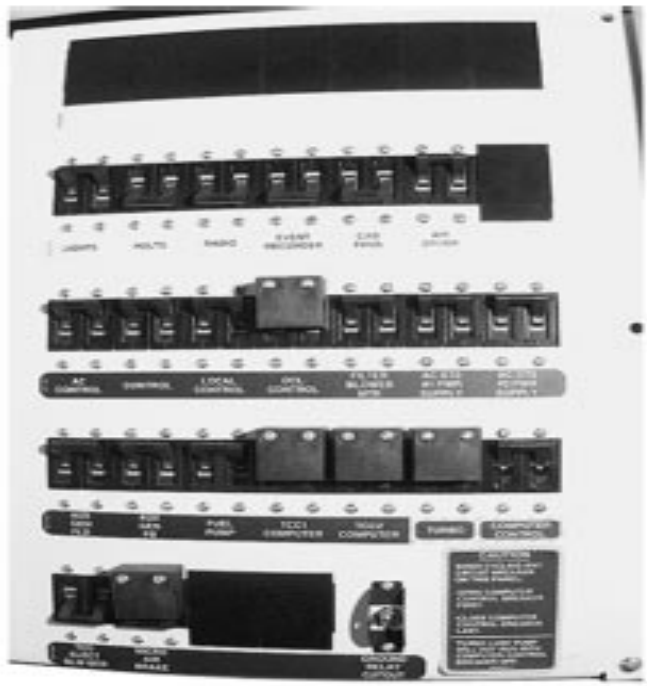


Figure 2-16. ECC1 Circuit Breaker Panel, Typical

Black labeled Section Breakers: **(4th Line)**

1) TCC ELECT BLW MTR Breaker : Protects the TCC Electronics blower motor circuit. This blower cools TCC Cabinet electronics equipment.

2) MIRCO AIR BRAKE Breaker : Provides Operating power to the Knorr air brake system and its cooling fans from loco Batteries/Aux Gen to the CCB computer.

3) GROUND RELAY CUTOUT Switch: This Toggle switch disconnects ground protection relay GR from the locomotive electrical circuits



Figure 2-17. Circuit Breaker and Test Panel

B) Circuit Breaker and Test panel:

Test panel : Test panel jacks allow maintenance personnel to measure the following voltages.

1. Main Generator (Traction Alternator)Field,
2. Companion Alternator Output,
3. Load Regulator,
4. Main Battery.

Circuit breaker panel : Black labeled Breakers

1) GEN FLD Breaker : Protects the traction alternator field circuit, also protects SCR and the Companion Alternator,

2) TCC1 BLOWER Breaker : Protects the traction control converter #1 blower motor,

3) TCC2 BLOWER Breaker : Protects the traction control converter #2 blower motor,

C) EM2000 Display panel: This is the display diagnostic system which is an interactive device provides an interface between the control computer and the loco operating crew.

EM2000 display panel consists of

1) Display screen : Directs operator by displaying messages on the screen.

2) Key pad : Provided with sixteen push button keys



(Function key assignments (F1,F2,F3 and F4 operations.)

F1: Change,
F2: Next,
F3: Select
F4: Exit.



D) Engine control panel : Consists control equipment used in loco operation.

1. Isolation switch : This is a two position rotary switch.

a) Start/Stop/Isolate position.
b) Run position.

2. DYN BRAKE CUT IN/CUT OUT Switch :

In Cut out Locomotive Dynamic Brake will not function.

2A. BLENDED BRAKE Switch(WDP4 Only):

The locomotive is equipped with a blended brake system. It simultaneously applies dynamic braking and air braking when the driver operates the automatic (train) air brake handles in the Service zone. (Percentage of loco brake during A9 operation in DB)

3. EXTERIOR LGHTS switch : Provides control of Platform lights.

4. MAINT ROOM LIGHTS switch : Provides control of Engine room.

5. EMERGENCY FUEL CUTOFF & ENGINE STOP Switch:

5A.Fuel Prime/Engine Start Switch(WDP4 Locos only) : For Cranking purpose.

6. Battery charging ammeter : Indicates the Battery Charging / Discharging.

7. Classification Lights switch : Rotary switch having three positions:

i) Cab end forward setting,
ii) Off setting,
iii) Long Hood end forward setting.

8. Alerter alarm : When Alerter Alarm sounds the driver must acknowledge it within the next 17 seconds to avoid a penalty brake application.

Miscellaneous internal equipment in the Electrical Control Cabinet:

This is provided in No #1 Electrical cabinet and consists of the following:

1. Main control panel (Relays, Resistors etc.,)
2. Locomotive Control Computer (EM2000)
3. Computer power Supply.
4. Digital Voltage Regulator Module.(DVR)
5. GTO (Gate Turn Off) Power supply.
6. Excitation panel.
7. 4 braking contactors.(B1,B2,B3 and B4)
8. DC link transfer switch.(DCL123,456)
9. Silicon Controlled Rectifier (SCR)
10. Battery Charging rectifier (BC)
11. Electrical cabinet Blower with filter in order to keep the components cool and dust free.

IV. TRACTION CONTROL CONVERTER COMPARTMENT(TCC Comp)

It consists of

A) TCC1 ,
B) TCC2 ,
C) Dynamic Braking Grids (8 numbers)
D) Dynamic Grids Cooling fans(two nos.),
E) TCC electronic blowers (two nos.) for TCC1 and TCC2, and
F) Blower for inertial filters (Dust Bin Blowers).

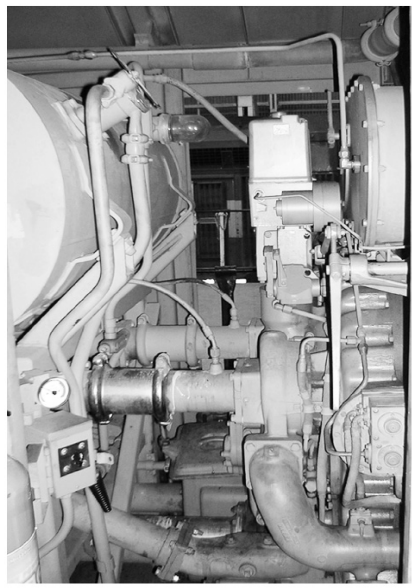
V. TRACTION GENERATOR COMPARTMENT:

Consists of following components:

A) Inertial air inlet filters for engine left/right air intake.
B) Traction Generator with companion alternator.
C) Traction Motor blower for all Six/Four Traction Motors.
D) Mai Generator Assembly Blower.
E) Auxiliary Generator.
F) Turbo super charger with two After coolers (on left and right banks)
G) Four Fiber Glass Baggie type Engine air intake filters.
H) Educator tube which maintains vacuum in the Lube oil sump is attached to Turbo, located on Loco right side with Lube oil Separator.
I) Battery Knife Switch and Starting Fuse 800 Amps, located on Loco Left side on the foot board.

VI. ENGINE COMPARTMENT:

A) Diesel engine with all accessories.
B) Engine starting motors (two in Number on Loco Left side).
C) Turbo lube oil priming pump (Soak back) is provided at the Loco left side.
D) In WDG4, Lube oil dip stick gauges are provided on both left and right banks of the engine.
E) In WDP4, Lube oil dip stick gauge is provided on loco right side only.



VII. ENGINE ACCESSORIES COMPARTMENT:

A) Wood word governor.

B) Water pumps (2 Nos.) for left and right banks. (Gear driven).

C) Lube oil pumps. (Gear Driven)

a. Scavenging pump : Draws oil from lube oil sump through scavenging and supplies to main lube oil pump through lube oil filter and cooler.

b. Main Lube oil pump: For piston cooling and engine lubrication.

D) Lube oil strainer housing consists of:

i) Two strainer elements

ii) Filter drain cock and strainer housing oil drain cock.

E) Lube oil Filter Housing consists of 5 filter elements (paper type)

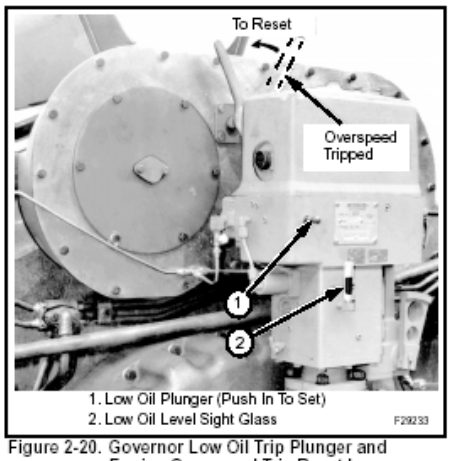


Figure 2-20. Governor Low Oil Trip Plunger and Engine Overspeed Trip Reset Lever

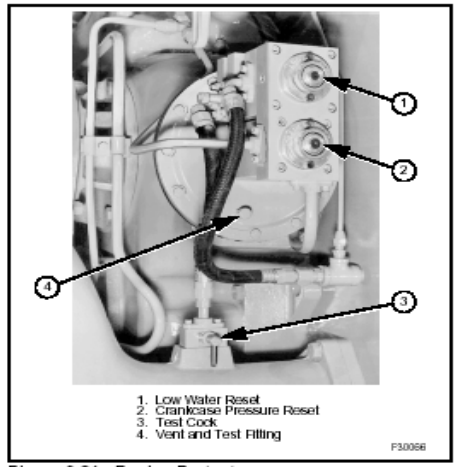


Figure 2-21. Engine Protector

F) Lube oil cooler.

G) Engine water tank with water level gauge and pressure vent cock (Pressure release cap) & water gauge at Loco right side,

H) Fuel primary filter

I) Fuel pump (Loco Left side)

J) Engine mounted fuel oil secondary filters (two nos.) spin-on type with sight glasses provided on Loco left free end side,

K) EPD(Engine protection device): Provided on Loco right free end side. Following are the protections by EPD:

- i) Low lube oil pressure protection switch on WWG,
- ii) Low water level/pressure protection Button,
- iii) Crank case Low pressure protection (CC Vacuum) Button,

L) Hot lube oil sensor/protector (Hot Oil Detector)

M) Fuel prime/engine start switch, provided at the Loco right side of engine equipment rack. (WDG4 Locos only)

N) Hand brake on Loco right side of engine accessories compartment (Will apply brakes for the 5th wheel only).

O) Water Drain COC On Loco right side bottom and Water Test Drain cock provided near EPD, Loco right side,

P) Lay shaft on Loco right side free end,

Q) Lube oil filter drum condition gauge on Loco right side,

R) Fuel oil filter condition gauge on Loco left side.

OST Handle is located which should be 45 degree towards loco left side.

VIII.COMPRESSOR COMPARTMENT : consists of

A) 2 stage, 3 cylinders air Compressor (water cooled by engine cooling system)
B) Inter cooler with Safety valve and Breather valve

IX.RADIATOR COMPARTMENT:

A) Radiators (two no.s) located on headers on top of the cooling fans.
B) Two radiator cooling fans (AC motor driven)
C) Main reservoir air cooling coils.

X.SUPER STRUCTURE OF LOCO CONSISTS:

A) Fuel tank of 6000 Liters capacity is provided between two trucks underneath the super structure.
B) 2 Main reservoirs are provided underneath the super structure above the fuel tank on Right side of loco.
C) Air dryer is provided at the Right side of the loco below super structure near fuel tank.
D) D 24 B feed valve (for F.P pressure) provided at Right side of loco underneath the super structure behind the MR2,
E) MR safety valve provided on Right side of the loco between MR1 & MR2.
F) Trucks BC cut out cocks are provided for each truck on Right side of the loco.
G) MR and BC equalizing cut out cocks are provided at both ends of locomotive on both left and right side of locomotive,
H) BP & FP angular cut out cocks are provided at both ends of the locomotive on Loco right side only.
I) 8 numbers of sand boxes are provided on wheel pairs 1,3,4 & 6.
J) Wheel flange lubricating spray nozzles are provided on both leading wheel sets.
K) Emergency Fuel cut off switches are provided on either sides of locomotive on top of Fuel Tank,
L) MR1, MR2, J-Filters and its COC are provided at Loco right side.
M) Cranking circuit board is located underneath the super structure on Right side of the loco in No # 2 Electrical Control Compartment, between Front Truck and Fuel Tank.
N) Battery box consists of Two Number of Batteries located underneath the Super structure between Front truck and Fuel tank (Loco Left side)

O) Radar: is provided to sense the actual ground speed and is provided in between front truck & fuel tank (loco Right side below No # 2 Electrical Control Compartment)

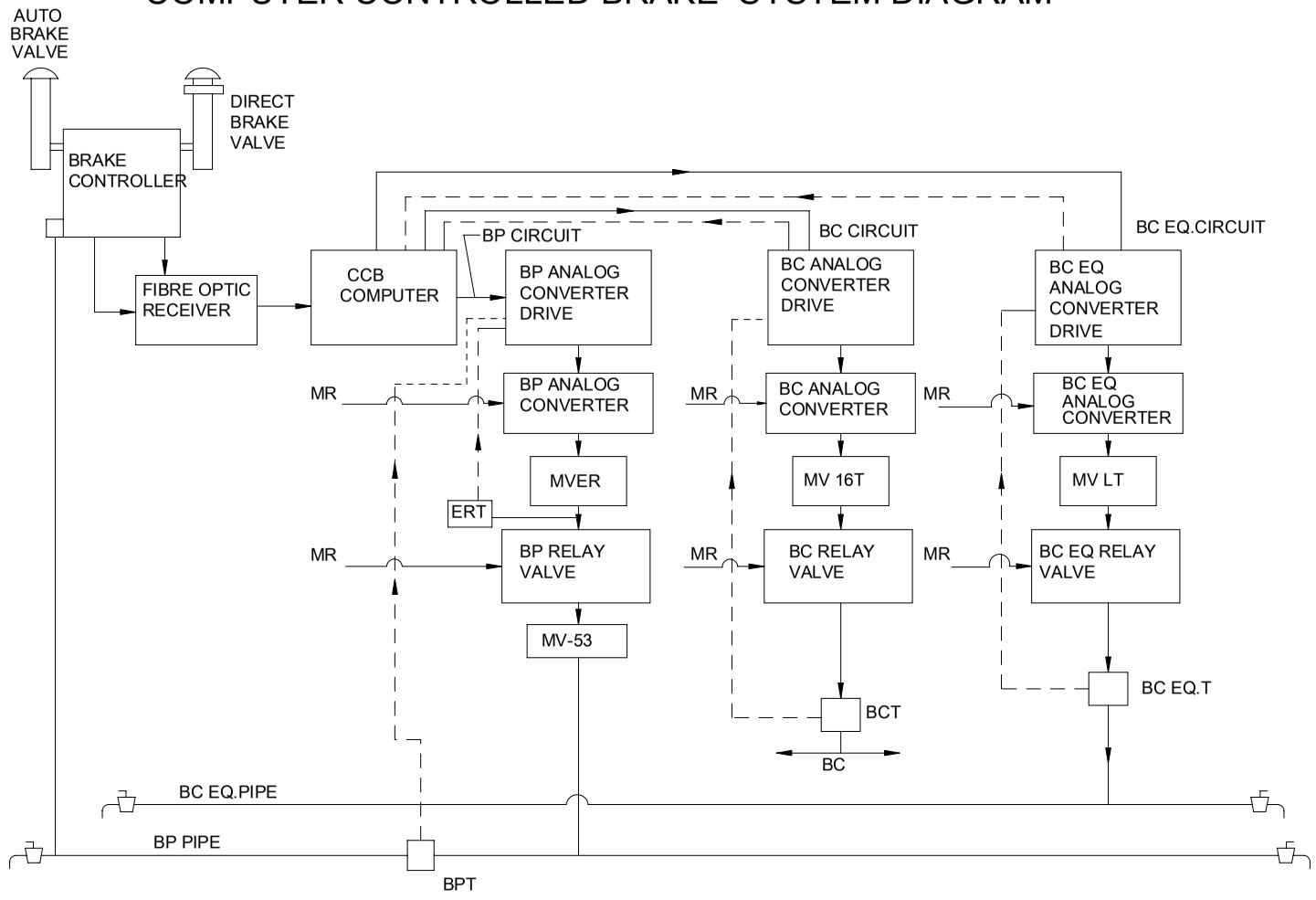
WDP4

P) Cranking circuit board is located underneath the super structure on Left side of the loco in No # 2 Electrical Control Compartment, between Fuel Tank and Rear Truck.

Q) Battery box consists of Ten Number of Batteries located underneath the Super structure between Fuel Tank and Rear Truck (loco Right side)

Radar: It is provided to sense the actual ground speed and is provided in between Fuel Tank and Rear Truck (loco Left side below No # 2 Electrical Control Compartment)

COMPUTER CONTROLLED BRAKE SYSTEM DIAGRAM



COMPUTER CONTROLLED BRAKE SYSTEM (CCB)

The loco is equipped with a computer controlled air brake system (CCB). The CCB equipment is a complete microprocessor air brake control system for passenger locos and goods locos. All logics are computer controlled. The driver uses one of the two controlled stands, cab control unit (CCU) to control the CCB system. Emergency applications are also initiated pneumatically in parallel with computer initiated emergency applications.

1. Brake valve controller (BVC) :

I)**Automatic Brake valve** (Auto Brake) : Having 5 positions.

a) Release/over charging (spring loaded) : BP = 5.7 kg/cm2 max.
b) Running : Equalising reservoir (ER) and BP = 5.2 kg/cm2 BCP=0
c) Minimum service : ER/BP reduce to 4.7 kg/cm2, BCP = 1.1 kg/cm2
d) Full service : ER/BP reduce to 3.4 kg/cm2, BCP = 1.8 kg/cm2
e) Emergency : ER reduces to 0, B.P reduces to < 1 kg/cm2 BCP = 1.8 Kg/cm2, BCEP = 1.8 kg/cm2

II) **Independent Brake Valve** (Direct Brakes) : It is having following positions

a) Release Position : BCP = 0
b) Application zone : Maximum brake position, BCP =5.2 kg/cm2, BCEP=5.2 kg/cm2
c) Bail off : When an automatic brake is applied, lifting the bail-off ring which is provided in the independent brake valve handle in any position will release BC as a result of BP reduction. Independent brake handle bail-off ring is spring loaded and by lifting it, the bail of function will be activated.

III) **Selector Switch or Air Brake Trail/Lead set up switch**:

The trail/lead airbrake set up switch is located on brake control next to independent brake handle. This switch has the following positions:

i) HLPR: Used during Banking loco working control stand.
ii) Trail : In Leading Loco non-working Control Stand and also for Trailing loco both the control stands.
iii) Lead : Used with loco in lead or controlling .
iv) Test: In working control stand used during brake pipe leakage-testing and also during attaching of locomotive on formation.

2. **Air Brake Equipment Rack:** Provided in the nose compartment consisting following:
   i) Voltage conditioning unit (VCU)
   ii) Computer relay unit (CRU) or Air brake computer
   iii) Analog converters
   iv) Magnet valves
   v) Pneumatic valves
   vi) Filters
   vii) Transducers
   viii) KE distributor valve (Back up valve)
   ix) Reservoirs

AUTOMATIC BRAKE SYSTEM FEATURES

As with conventional brake systems, the CCB system controls the locomotive and train brakes through control of the train line brake pipe pressure. Control of BP pressures permits the development of brake cylinder pressure on both locomotive and train. Control BP pressure is accomplished by control of a smaller volume of equalizing reservoir (ER). ER pressure is reduced to apply brakes and increased to release brakes. Brake cylinder pressure develops at a controlled rate according to the brake pipe pressure reduction.

The CCB system utilizes two distinct control circuits to apply and release an automatic brake i.e., BP control circuit increases or decreases the BP pressure according to the pressure commanded by ER control. BC control circuit controls the increase or decrease of brake cylinder pressure commanded by BC control pipe pressure.

INDEPENDENT BRAKE SYSTEM FEATURES

The independent brake when operated with a forward motion develops brake cylinder pressure on the locomotive only. Pressure is developed much faster than the automatic application. At the same time brake cylinder equalizing pressure also develops to regulate the trailing loco brakes.

The independent brake valve is also used for a faster release of the automatic brake. When the bail-off ring on the independent handle is lifted, both BC and BCEP pressures are vented at the lead unit releasing the automatic loco brakes on the lead unit at the trailing units. If an independent brake also applied, these brakes would remain applied.

BRAKE PIPE CONTROL SYSTEM

According to the automatic brake valve controller handle position, signals from the brake handle will go to fiber optic receiver (FOR), then to the air brake computer. Computer will send signals to Analog converter.

The Analog converter operates magnet valves provided in it and from the magnet valves piloting air pressure will go to another main magnet valve which is controlled by CCB computer. The out put air pressure of the main magnetic valve is called as equalizing reservoir, which acts as a piloting pressure for the BP relay valve. BP relay valve is a self lapping pressure maintaining pneumatic valves which maintains the BP pressure to the level of ER against train brake leakage conditions.

There are transducers provided in the ER pipes and BP pipes to send feed back signals to the computer regarding the pressures available or maintained in the respective pipe lines. Computer will take corrective action to maintain the required pressures.

Emergency Applications: An emergency application means to apply brakes at the maximum rate. When the brake valve handle is placed in the emergency position, ER reduces at a faster rate to zero pressure and also the brake valve mechanically opens a vent valve, that exhausts the brake pipe directly venting BP to out the entire length of the train. In addition, the brake controller is provided with a switch which opens sending an emergency signal to the computer. Then the computer energizes an emergency magnet valve (MVEM). The opening of MVEM vents the pilot port of the high capacity BP relay pneumatic valve (PVEM), exhausting BP pressure.

Automatic Brake Application on Loco: The brake pipe transducer (BPT) provided in the BP detects the reduction in BP and sends signals to computer. The computer calculates the required brake cylinder pressure and commands the BC Analog converter to maintain the desired rate of pressure level in the brake cylinder. The brake cylinder analog converter operates a BC magnet valve. The output pressures of the BC magnet valve works as a piloting air pressure for the BC relay valve. BC relay valve is a self lapping pressure maintaining pneumatic valve which will come to the LAP position when matches with the BC pilot air pressure. The application is complete if the BC pressure is maintain at the level commanded by the computer until the brake valve handle is again moved.

Bail-off automatic application: When the automatic brake is applied, lifting the bail-off ring provided in the independent brake handle with brake handle in any position will release brake cylinders of the loco.

On the lead unit, the CCB computer commands the BC analog converter to release the BC pilot air pressure which in turned drives the BC relay valve to release the BC pressure. If an emergency brake had been made the brakes would re apply to maximum as soon as the bail-off ring is released.

NOTE: If the bail-off continuous for longer than 50 seconds, the BC pressure will be restored and a fault will be displayed on the EM-2000 display screen.

The crew message is the center point of display and it will indicate fault condition that required immediate attention.

INDEPENDENT BRAKE OPERATION: According to the independent brake valve controller handle position, signals from the brake valve handle will go to fiber optic receiver (FOR) then to the computer. Computer will sends signals to the BC analog converter. The analog converter operates magnet valves provided in it and from these magnet valves, pilot air will go to another BC main magnet valve. The out put pressure of the BC main magnet valve works as a pilot air pressure for the BC Relay valve.

BC Relay valve is a self lapping, pressure maintaining pneumatic valve which maintains BC pressures in the Brake Cylinders of the loco according to the piloting air pressure supplied by the BC main magnet valve which in turn controlled by CCB computer.

Any leakages in BC pipe will be noticed by the BC Transducer (BCT) and the feed back signals will go to CCB computer. Then computer will in turn take corrective action to maintain BC pressure. The BC equalizing pipe (BCEP) is used to supply air to all trailing units of the locomotive consists to controlled application and release of both automatic and independent brakes. The only exception to this operation is locomotive consists separation.

According to the service positions of the brake controller valve handles, CCB computer gets signals from the FOR. Then the computer sends the signals to BCEP analog converter to supply piloting air pressure to BCEP Relay valve.

When the BC pressure equalizes BCEP, the BCEP Relay valve moves to LAP position.
Maximum BCEP = 5.2 kg/cm^2.

LOSS OF POWER SUPPLY TO CCB COMPUTER

LEAD UNIT: With no voltage to CCB computer (CRU), no components can be energized to apply brakes. The normally energized magnet valves will be de-energised. Equalizing reservoir (ER) begins reducing through magnet valve to atmosphere.

As equalizing reservoir pressures decreases at the BP relay valve, the relay valve in turn begins to vent BP pressure. With the BP pressure reducing at the KE back up valve, the pre-control pressure develops and flows to the BC relay pneumatic valve. The BC relay valves will develop brake cylinder pressure.

TRAIL UNIT LOCO BRAKE OPERATION: The increase of BCEP at the trail unit is sensed by the BRAKE CYLINDER EQUALIZING PIPE TRANSDUCER located at the brake cylinder equalizing valve. The signals from the transducer is feed back to the CCB computer of the trailing unit. The computer calculates the pressure required in the brake cylinders based on BCEP pressures. At this point CCB computer commands the BC analog converter to increase no.16 control valve at the same rate as BCEP. No.16 pipe air works as a piloting air for BC relay valve.

The maximum brake cylinder pressure that can be obtained on the trailing unit for automatic as independent brake application is same as the lead unit pressure .

INDEPENDENT BRAKING HELPERS SERVICE (BANKING): When a locomotive is to be used to push a train i.e., for banking , the lead/trail switch should be positioned to HELPER. This allows operation of independent brake while keeping the automatic brake cut-out.

LOCOMOTIVE CONSISTS SEPERATION-LEAD UNIT: When consist is accidentally separated, all the end hose pipes immediately begins exhausting the pressures within the few seconds, MR equalizing pipe pressure reduces nearly to 0. When the pressure reduces less than 4.2 kg/cm2, the CCB computer detects the dropping pressure through main reservoir equalizing transducer (MRET). The computer commands BCEV to revert to the trail mode. The BCEP pipe is now isolated from the brake system preventing any pressure from venting out through the BCEP end hose pipe.

With the BP hose pipe open, BP reduces to zero at a rapid rate. BC pressure begins to increase as if an emergency application is in effect, since the second main reservoir is captivated by one way check valve to the first main reservoir, main reservoir is preserved for use of the brake cylinder.

LOCOMOTIVE SEPERATION – TRAIL UNIT : The trail unit is also detects the loss of MREP through its own MREP transducer. The MREP transducer sends the signals to CCB computer about the loss of MREP pressure and then the computer commands the brake cylinder analog converter circuit to operate the same as the lead unit, brakes are applied by the computer control system to an emergency level. In both the above cases MREP must be re-stored to 8.4 kg/cm2 and above to re stored normal brake operation.

AIR BRAKE SELF TEST PROCEDURE ON WDG4 & WDP4 LOCOMOTIVE

Air brake self test is to be conducted on WDG4 and WDP4 locomotive under following conditions.

1. Failure of control stand selection(Change of control stand if wrongly done)
2. During any Air brake failure on run.

Step. 1

Following safety precautions are to be strictly followed before conducting air brake self test.

1. Stop the locomotive/train.
2. Apply "Hand brake" on locomotive.
3. Secure the formation, which should not roll during self test.
4. Ensure minimum MR pressure of 110 PSI.
5. Close BP and FP angle COC's on locomotive and on formation.
6. Close MR and BC equalising COC's on both ends of locomotive.
7. On working control stand :
    a) Keep reversor handle in "Neutral" position.
    b) Keep automatic brake handle in "Run" position.
    c) Keep independent brake handle in "release" position.
    d) Lead/Trail switch in "Lead" position
8. On non working control stand :
    a) Keep automatic brake handle in "Full service" position.
    b) Keep independent brake handle in "Full application" position.
    c) Lead/Trail switch in "Trail" position.

On fulfilling .,safety precautions, Air Brake self test is to be conducted.

AIR BRAKE SELF TEST PROCEDURE

On EM – 2000, using Key buttons;-

1. Press "Main menu" key.
2. Using down arrow key, bring curser to "Self Test" menu.
3. Press "F2" key to go to "Next" page.
4. Using down arrow key, bring cursor to "Air Brake Test".
5. Press "F3" or "SELECT" key to select Air Brake Test.
6. Entry conditions for Air Brake Test will be displayed on the screen, which are already fulfilled.
7. Press "F1" key to .continue test.
8. EM-2000 initiates Air Brake Self test. On completion of test, 'SUCCESSFUL TEST COMPLETED, NO DEFECTS FOUND' will be displayed on EM – 2000 screen.
9. Press "F4" key three times to go back to "Main menu".
10. Using up arrow key keep ,the cursor on "DATA METERS" .
11. Keep Independent brake handle to "Release" position on non working control stand.
12. Further, connect BP and FP pipes of formation and open angle COCs to create BP and FP.

PROCEDURE FOR CHANGING THE CONSOLES IN WDG4/WDP4 LOCOMOTIVES.

CONVERTING THE WORKING CONSOLE AS NON-WORKING CONSOLE.

1. Keep isolation switch in START/STOP/ISOLATE position.
2. Keep Reversor Handle in NEUTRAL.
3. Throttle in idle.
4. Move auto brake handle (A.9) to FS (Full service) position. Wait for BP pressure and Equalizing pressures drop to stabilize.
5. Release loco brake (SA.9) and wait for brake cylinder pressure to drop to stabilize.
6. Move L/T switch from LEAD to TRAIL position.(Equalizing pressure should drop to zero)

Now the working control stand is made Non – working and loco brakes are in applied position.

CONVERTING THE NON WORKING CONSOLE AS WORKING CONSOLE

1. Insert Reversor and make sure it is in Neutral Position. (This should be done only after all the steps given above are completed first.)
2. Ensure Throttle in Idle.
3. Auto brake (A9) to be kept in 'Run' position.
4. Independent (SA9) brake should be kept in applied position.
5. Move L/T Switch from TRAIL to LEAD.

Note:- After operation of the every item, observe the needle stabilization and sound to be stopped then only operate other item.

SAFETY ITEMS ON WDG4 LOCOS

1. Cattle Guards.
2. Rail Guards
3. Screw couplings of CBC
4. Rod primary interlocks of axle adapters
5. Center Pivot button locking plate
6. Traction Motor nose links
7. Truck Center Pivot Assembly
8. Rod assembly car body
9. Hand Brake assembly
10. Brake hangers, Brake blocks and brake heads
11. Locking plates for axle roller bearings
12. Brake pull rod
13. Horns
14. Wipers

15. Sanders
16. Fire Extinguishers
17. Brake block keys
18. Axle Thrust pads
19. Truck Safety links
20. Air flow indicator
21. Pressure Gauges (BP,FP, BC)
22. Brake Cylinders
23. Head lights
24. Classification lights
25. Flasher lights
26. Event Recorder
27. Coil springs
28. Wheel Assembly
29. Bogie frame
30. Wind shield glass, cab door glass and window glass
31. Side Buffers
32. Brake controller
33. Voltage conditioning unit of CCB
34. Computer relay unit of CCB
35. Pneumatic Relay unit of CCB
36. Magnet valves of CCB
37. Engine Man's Emergency Valve.

AIR BRAKE TROUBLE SHOOTING FOR LOCO PILOTS

S.No	CAUSE / DEFECT	REMDDIAL ACTION
1.	MR Pressure Dropping	1. Check for air leakages from FP,BP,BC,Auto Drain, Air Dryer, Radar Blow, Sanders and Cooling coils. 2. After attending ensure engine RPM coming to idle (During air leakages, engine RPM will increase due to AIR Compressor operation)
2	Unusual sound from compressor	1. Check for correct compressor oil level if found less than low mark shut down the loco and inform shed. 2. If any unusual sound from LP and HP cylinder inter coolers and safety valve or any air leakage inform shed to take advice whether to continue working or not.
3	Improper loading and unloading of air compressor	1. Close MR1 'J' filter COC and drain out the trapped moisture in MR1 system through MR1 'J' filter drain cock , when MR safety valve starts blowing keep MR1 COC to normal open condition. 2. Close MRPT COC drain and trapped moisture by pressing the spring loaded MRPT quick connector stem, ensure increase in ENG RPM with blowing of MR safety valve and then kept MRPT COC to normal open position 3. If the trouble still continues close MRPT COC and clear section take advise from shed for further movement. 4. Recycle computer control circuit breaker the trouble may set right. 5. MVCC stuck up, improper loading press and release the 'T' handle on the MVCC unit.
4	BP dropping and PCs knocking out	1. Check AIR FLOW indication for needle shooting 2. Check the leakages on the formation and arrest the same 3. Check for any air leakage from both consoles. This may be due to stuck up Automatic or Fireman Emergency air valves. 4. If Automatic brake Emergency valve is stuck up in open position, throw A/B handle to emergency sharply 2 or 3 times and then bring to Run position to RESET. 5. If A/B emergency valve air leakage continues, Dummy the air passage with dummy cap of BC equalizing pipe. 6. Check if AEB circuit breaker input ON
5	Air brake failure with crew message	1. Recycle MAS (MICRO)AIR BRAKE as per recycling procedure 2. Conduct Air Brake self test 3. If problem still continues 4. Air brake failure use locomotive in trial only.

Note: At time SELF TEST may fail but Air Brake system works normally in such case give message and work up to destination.

AIR BRAKE SYSTEM – TROUBLE SHOOTING IN GHAT SECTION

S.No	Type of Trouble	Action to be taken to clear the section
1.	MR pressure dropping with EM-2000 – crew message "LOW MAIN RESERVOIR EQUALIS- ING PRESSURE USE LOCOMOTIVE IN TRIAL ONLY" FC 2977 in lead working loco	If unable to attend, close MREQ in both LEAD and TRIAL loco MU end. Keep LEAD TRIAL switch in lead loco from LEAD mode to TRIAL mode, and keep TRIALING loco TRIAL mode to LEAD mode
2	If MR pressure dropping other than LEAD loco	The loco where the MR is dropping both end MREQ COC to be closed.
3	BC EQ _ Hose pipe burst causing MR pressure dropping	Close the BCEQ COC in both end of the MU coupled locos. The TRIALING loco which is disconnected from BCEQ towards the train end LEAD TRIAL switch to be moved from TRIAL mode to HLPR mode.
4	"AIR BRAKE FAILURE USE LOCOMOTIVE IN TRIAL ONLY" FC 2975 in LEAD/HLPR loco if experienced with BP leaking	Keep LT switch from LEAD/HLPR mode to TRAIL mode and keep TRIALING loco LEAD TRIAL switch from TRIAL mode to LEAD/HLPR mode duly ISOLATING BP TO LEAD loco to avoid BP leaking.
5	Air brake failure other than LEAD/HLPR mode locos in MU's (or) TLC	Permitted to work continuously from LEAD/HLPR loco. Whenever the failed loco required to work LEAD/HLPR AB self test to be conducted to clear the fault.
6	Air Brake failure in the MU HLPR mode loco (down the ghat (or) TLC (up the ghat)	Keep L/T switch from HLPR mode to TRIAL mode and keep L/T switch in MU/TLC loco from TRIAL mode to HLPR mode.
7	Air brake penalty not getting reset even after keeping auto brake handle 10 seconds in FS or 60 seconds in emergency position.	Keep auto brake handle in run position and keep L/T switch from LEAD mode to TRIAL mode for 10 seconds again keep from TRIAL mode to LEAD mode. If problem still exists recycle MICRO AIR BRAKE BREAKER with COMPUTER CONTROL BREAKER.

S.No	Type of Trouble	Action to be taken to clear the section
8	At any situation 2 control stands in one MU consist the L/T switch should not be kept in LEAD/HLPR Mode.	If both control stands L/T switch by mistake happened in LEAD/HLPR MODE then A/B self test to be conducted to clear the fault to work in LEAD / HLPR.
9	To make LEAD MODE MU consists to couple with another MU consist any one control stand to be kept in HLPR MODE only.	BCEQ pipe should not be connected between LEAD MODE MU/TLC and HLPR MODE MU/TLC.

TROUBLE SHOOTING OF FAULTS ON WDG4/P4 LOCOMOTIVES

S.No.	Fault	Items to be checked	Action to be taken by Crew
1	**AUTOMATIC SHUT DOWN OF THE ENGINE**	Check for LLOB tripping	RESET LLOB
		Check for EPD tripping	a. If EPD trips, RESET button and also RESET LLOB button
		Note: Whenever EPD button trips, it will always be accompanied with the tripping of LLOB button	
		OSTA Tripping	RESET OSTA
		Note: In case of OSTA tripping, it is likely that LLOB and EPD may also trip. Hence, also check the LLOB and EPD buttons. In case they are tripped, RESET them also.	
		Check for mal-functioning of master controller	Check throttle position in the EM 2000 display. If it shows "STOP" change control stand and work. If the position is not rectified, check for tightness of the couplers 543AB and C in Short hood control console.
		Check for position of MU stop button	If it is accidentally pressed RESET it
		Note: In this case, computer shall display "MU STOP REQUEST"	

		Check for tightness of rack physically moving lay shaft	If the lay shaft is not moving at all, or is tight, Try to re-crank the loco and clear the section.
		Note: In case of rack stuck up, EM 2000 shall display the message "GTO POWER SUPPLY 1 UNDER VOLTATE" AND "GTO POWER SUPPLY 2 UNDER VOLTAGE", "ENGINE SPEED FAILURE" AND "DC LINK UNDER VOLTAGE".	
		Check for bubbles in return sight glass, i.e., fuel sight glass nearer to the engine block while priming. Also check for oil in by pass sight glass.	If return sight glass is having bubbles, tighten the spin-on-filter and strainer and re-crank the loco. If the bubbles are still present. Try to clear section and ask relief loco. If by pass sight glass is full of oil & return sight glass has no oil, nothing can be done. Ask for relief locomotive.
		Check for red LED indication in PRG, PSM modules	Inform shed and seek advise
		Check for red indication in any of the EM 2000 modules	Inform shed and seek advise
		Check for tripping of slide switch for fuel pump	RESET slide switch and re-crank the locomotive
		Note: If any of the above problems are noticed and engine is shutting down with speed bogging down, disconnect the AMPHENOL plug and try to re-crank. If the loco is not cranked after removal of AMPHENOL plug, nothing can be done and relief loco has to be asked for. If loco is cranked, consult shed.	

S.No.	Fault	Items to be checked	Action to be taken by Crew
2	REDUCED POWER/ POWER NOT COMING AS PER THE NOTCH	Check for bubbles in return sight glass i.e. fuel sight glass nearer to the engine	a. Ensure tightness of filter, fuel strainer & fuel primary drain cock should be in closed condition. b. Ensure that minimum 1500 ltrs. Of diesel is available in Diesel tank.
		Check for radiator fans not working	a. RESET radiator fan breaker if provided. b. Check for any visible loose connection in radiator fan circuit in ECC3. c. Swap DIO 1 and 3 d. Radiator fan fuse might have blown, nothing can be done, work in lower notches if the train load permits, INFORM SHED.
		NOTE: If radiator fans are not working, EM 2000 shall display "REDUCED POWER – THROTTLE 6 LIMIT".	
		Check for TCC over temperature	Work in lower notches if possible, else wait for a while and allow TCC temperature to come down, then work further. If the message appears only in one TCC, that particular TCC can be isolated, if the train load permits.
		Check for Traction Motor over temperature	Work in lower notches if possible, else wait for a while and allow TM to cool down, then start again.
		Note: In case of TCC over temperature and TM over temperature, message shall be logged in EM 2000 showing "REDUCED POWER TCC OVER TEMPERATURE" or "REDUCED POWER HOT TRACTION MOTOR"	

		Check for throttle position in EM 2000	If EM 2000 does not display same throttle position as the actual throttle position, change the control stand and work further.
		Check for speed and power fluctuation	Ensure tightness of AMPHENOL plug in the Governor. If the problem persists, seek advice from the shed.
		Note: Full ENG HP will not be achieved at lower speeds since load regulation is based on Tractive Effort. Full HP will be achieved at about 25 KMPH.	

S.No.	Fault	Items to be checked	Action to be taken by Crew
3	**TRACTIVE EFFORT METER NOT RESPONDING (LOAD METER NOT RESPONDING)**	Check PCS in knocked out	Recover PCS as per the message displayed in EM 2000
		Check in Governor AMPHENOL plug tightness	Tighten the AMPHENOL plug
		Check the position of engine RUN switch	Switch on the engine run switch (it should be UP)
		Check the throttle position in RM 2000 display	If the throttle position is not tallying with the actual throttle position, change the control stand and work further.
		Check the tightness of couplers 543A, B & C	Tighten the couplers in control stand
		Check the DIO card failure (there will be no indication in EM 2000)	Swap DIO cards 1 & 3 or 2 & 3. If the problem sets right work further, else seek advise from the shed.
		Check the locked axle message in EM 2000 display	Ensure the movement of that particular axle physically. If the wheel is

			rotating freely, disable the speed sensor through EM 2000 and work further.
		Check for message "NO COMPANION ALTERNATOR OUTPUT – NO AUXILIARY GENERATOR OUTPUT"	Check AG drive shaft is intact. If shaft is broken, ask for relief locomotive and INFORM SHED. b) DVR may be defective, nothing can be done and ask for relief locomotive and INFORM SHED
		Check for AG field/feed back breaker tripping in breakers panel	If tripped RESET and work further
		Check for AG circuit breaker in ECC2	a. If tripped RESET and work further
		Check for position of isolation switch.	Keep in ON position (UP)
		Check for position of GF switch	Put in ON position (UP)
		Check for GF breaker in breakers panel	Put in ON position (UP)
		Check for crew message	Act according to the crew message
		Check for reverser input in power data in data meters. This will be shown in "OPMODE" This should show "PROP"	If OPMODE does not show PROP, change control stand.

S.No.	Fault	Items to be checked	Action to be taken by Crew
4	**GROUND RELAY TRIPPING**	Check for crew message. If it shows "GR-Power"	a. Isolate trucks one by one and isolate in which truck GR is tripping. Truck causing GR tripping may be isolated and work further.

		If the crew message shows "GR-DB. Load test"	Isolate DB side switch provided in engine control panel and work further
5	**TCC RELATED PROBLEMS**	Check crew message – TCC internal RESET...	It causes automatic reset of TCC and Loco Pilot need not do anything. Train can work further without any problem
		TCC communication link failure	Recycle that particular TCC computer breaker along with EM 2000 computer breaker
		TCC failed to acknowledge DB request	
		TCC failed to acknowledge LOAD request	
		TCC failed to acknowledge DIRECTION request	
		TCC internal RESET – NO speed detectable	Nothing is required to be done and train will work normally
		TCC #n lock out….	Recycle the TCC computer breaker. If the message disappears, work further. If the message continues to appear, isolate the particular truck, if the train load permits
6	**LOCKED WHEEL – SPEED SENSOR FAULT**	Verify free rotation of the wheel by moving locomotive	If it freely rotates, disable that particular speed sensor and work further
		Note: If the message does not disappear even after disabling the speed sensor, dis-engage the speed sensor connector on the TM. After disabling the speed sensor computer will show "TCC # n speed sensor disabled for locked wheel detection. IGNORE THE MESSAGE & WORK FURTHER In case for any reasons, recycling of computers is done, speed sensor becomes enabled automatically. Hence, it is required to be disabled again after	

		recycling. Also compare the axle bearing temperature with the adjacent wheels. If there is no abnormal difference, it is safe to work duly disabling the speed sensor Also the speeds of Traction Motors in terms of RPM can be checked in "SPEED METER screen in data meters. There should not be any abnormal variation.	
7	**TCC BLOWER CONTACTOR PROBLEM**	Check crew message, Reduced Load TCC #n blower computer breaker is not closed	Check for tripping of TCC computer breaker or TCC blower breaker. If tripped, RESET.
		If blower breaker is repeatedly tripping	Open the circuit breaker panel and by pass the feed back interlock wires (Wire Nos. MULA 7 & MULAX for TCC1, MULB7 & MULBX for TCC2) The wires are to be removed from the interlock terminals and joined together & insulated. INFORM SHED.
		TCC #n blower contactor failed to pick up	Isolate that particular truck and work further. If the load does not permit to work on single truck, contact the shed & seek advice.
8	**EXPERIENCING JERKS IN UNDER TRUCK**	Check the speed sensor fault. It will be indicated in EM 2000 display screen.	Isolate defective speed sensor duly ensuring free rotation of the wheel and work further.
		TCC – problem, it will be indicated in EM 2000 screen	Isolate the particular truck as indicated in EM 2000 display screen & work further.
		Select creep control in data meters and check for the value of N + dN during run. If it	Check for cleanliness of Radar face plate. If it is dirty clean it. Also check for tightness and

		indicates3600 on free run.	intactness of the Radar cable and plug.
		Check for proper working of sanders	If sand not coming, check for availability of sand in sand boxes. If sand is available in the boxes, close the nozzle by hand and operate the sander manually to clear any blockage and ensure free flow of sand.
		Check for Traction Motor cables in the under gear	If any of the cable is found cut or disconnected, disable that particular truck and work further – INFORM SHED
		Jerk during DB	Stop the locomotive, select DB in data meters and check uniform increase of TL24R voltage from 0 to 74 Volt as the throttle handle is moved in DB zone from set up to 8th notch. If it is not uniform and it suddenly increases to maximum voltage isolate DB and work further.
9	**DIGITAL INPUT SYSTEM FAILURE**	Check for crew message – Digital input system failure – check mux circuit.	Swap DIOs 1 or 2 with 3 duly putting OFF computer breaker and ensure usage of static wrist band.
10	**AIR BRAKE SYSTEM PROBLEMS**	Check for crew message – communication link failure MAB	Recycle micro air brake and computer control breakers,
			Check for tightness of COM card of EM 2000

			Check for tightness of CPZ card in CCB system
		Air brake failure - use locomotive in LEAD only	INFORM SHED AND WORK FURTHER
		Air brake failure - use locomotive in TRIAL only	Check for availability of MR pressure. If available recycle micro air brake and computer control breakers – conduct air brake self test. If MR pressure is not available, consult shed.
		Air brake fault – BC control failure	Check for tightness of EPA2 front connector and conduct air brake self test.
		Air brake fault – BP control failure	Check for tightness of EPA1 front connector and conduct air brake self test.
		Air brake fault – BC equalizing control failure	Check for tightness of EPA3 front connector and conduct air brake self test. Check for tightness of BC equalizing valve connector
		Air brake fault – Brake controller # n failure	Check for availability of MR, ER and BP pressures. If these are within the limits work further and avoid holding "BAIL OFF" switch. If the pressures are not within the limits, change the control stand and work further.
		No blended brake – Lock out	Conduct blended brake self test. Even if it does not pass, work further and INFORM SHED

		Loco brake not releasing	Conduct self test
11	**MR PRESSURE DROPPING**	Check for any external leakage in air flow indicator	Arrest the leakage
		Check for unusual sound from compressor valves	CONSULT SHED
		Check for normal operation of air dryer	If it is continuously pumping – put OFF air dryer breaker and work further – INFORM SHED If after putting OFF beaker also, it is continuously pumping, shut down loco. Drain MR1 and plug the defective purge valve using a coin and then re-crank the loco.
		Check ABD valve working continuously	Bring the plunger in manual position and drain MR manually at every train stoppage.
		Pneumatic pipe connecting MRPT in compressor compartment may be clogged with moisture	Close the cut out cock and drain moisture from test plug. Open the cut out cock and again give blow down. Finally open cut out cock and work further.
		Any sanders working continuously	Close MR1 cut out cock and drain out trapped pressure through MR1 J filter. Open MR1 cut out cock and work further.
		Any horns working continuously	

12	**SIMULTANEOUS FORWARD/REVERSE REQUEST**	Check for crew message –No load simultaneous forward/reverse request with alarm	Check for position of reverser handle in control stand. Also check for reverser input in program meter or in power data. In power data, the reverser input is indicated as OPMODE – PROP when it is in Forward or Reverse. Keep the reverser in neutral and see that reverser input will show idle and in program meter RHSF & RHSR shall show OFF. If it is not so, operate the reverser handle forward by reverse direction till such time it correctly shows.
		Note: When Reverser is in centre, RHSF & RHSF shall show 'OFF' in program meter as soon as it is in Forward RHSF will be "ON" & RHSR will be "OFF', If reverser is kept in Revese, then "RHSF will be "OFF" and RHSR will show "ON"	
13	**SIMULTANEOUS POWER / DB REQUEST**	Check for crew message – No load simultaneous power/ DB request.	Check throttle position in EM 2000. It should show idle whenever throttle is kept in idle. If it is not so, operate the handle in both the control stands and see that throttle position comes to idle. If it does not set, take throttle in DB zone and again bring to idle. Check throttle position on both the controllers in idle.

14	**HEAD LIGHT NOT WORKING**	Check for working of both the bulbs	If one bulb is fused, INFORM SHED and work further
			If both the bulbs are not glowing in long hood side, check the tightness of 823C, 823D plugs in ECC3.
			If both the bulbs on Short hood side are not working, check for any loose cable connection in head light dim resistance inside ECC1 top right corner.
15	**FLASHER LIGHT NOT WORKING**	Check for flasher light switch position, it should be ON. Also all the breakers in breaker panel should be ON	If the breakers are ON, and problem persists, Swap DIO 1 & 3 and heck for all the flasher switches in 'ON' position in both the control stands Check for flasher working by applying emergency brake. If flashers are working, start train.
	FLASHER LIGHT WORKING CONTINUOUSLY	Check for the flasher switch position in both the control stands	If they are in ON position, put OFF the switches
			If the switches are in OFF position and problem persists, Swap DIO 3 with 1
		Check for PCS knocked out	Recover PCS
16	**WHITE SMOKE IN EXHAUST**	Check lube oil level	If lube oil level is increased, consult shed
17	**WATER LEVEL REDUCING**	Check for any external leakages	Open pressure relief valve by pulling the handle and tie it. Clear the section and consult shed.

ISOLATION OF TRUCK

When it becomes necessary for any reason like power ground etc. to isolate a truck the following procedure to be followed:

1) Stop the loco
2) Secure the control stand:
   a) Reverser - Neutral
   b) Throttle - Idle
   c) ER & GF - OFF
   d) Isolation Switch - Isolate Position

On computer select

1). Main Menu
2). Traction cut out

MAIN MENU	
Data Meter	Fault archive
Self test	Running totals
Unit information	English/Metric
>Traction cut out<	Lock wheel detect
Select	exit

To disable a particular truck
Keep cursor at the side of truck 1
Or truck 2 which is to be cut out
and Use F3 function key to disable

F3

TRACTION STATUS		
< Truck 1	< TRACTION	ENABLED
< Truck 2	< TRACTION	ENABLED
	DISABLE	EXIT

After disabling a particular truck
Computer will display as follows

F3

TRACTION STATUS		
< Truck 1	< TRACTION	DIABLED
Truck 2	TRACTION	ENABLED
	ENABLE	EXIT

NOTE: After disabling truck

First clear the section.

Speak to PRC and decide load to be cleared.

You can clear 60% of load with one truck.

For empties or passenger/Express train no reduction in load.

Dynamic brake can be used for working truck.

LOCKED WHEEL

When locked wheel takes place it may be due to actual locked wheel or it may be a speed sensor fault. The loco pilot will experience the following indications.

1) Alarm }
2) TE Meter drops } Observe computer Screen
3) No Load }

Alarm
No Load
4 lock wheel detected
Check and verify
If wheel rotates

Actions by Loco Pilot: On experiencing the above first check for locked wheel. Move the loco and ask the Asst. Loco pilot to observe the wheel movement of all the wheel especially wheel No: (As indicated on computer) If the wheel not rotating fail the loco on the spot and check the journal bearing. Try to inform PRC/Shed immediately.

If all wheels are rotating freely, it means it is a speed sensor fault, check and secures broken speed sensor cable and plug end. Disabled the particular speed sensor and work onwards with full load.

For disabling a Speed Sensor secure the control stand keep

1) Reverser - Neutral
2) Throttle - Idle
3) ER & GF - OFF
4) Isolation switch - Isolation side

On computer select

1) Main menu
2) Locked wheel detect

LOCKED WHEEL STATUS			
AXLE 1	ENABLED >	AXLE 4	ENABLED <
AXLE 2	ENABLED	AXLE 5	ENABLED
AXLE 3	ENABLED	AXLE 6	ENABLED

DISABLE

F1

Locked wheel status displays on computer screen. Now keeping cursor on required axle speed sensor to be cut out use F1 function key to cut out Particular speed sensor. After disabling speed sensor Computer displays as below

LOCKED WHEEL STATUS			
AXLE 1	ENABLED >	AXLE 4	DISABLED <
AXLE 2	ENABLED	AXLE 5	ENABLED
AXLE 3	ENABLED	AXLE 6	ENABLED

F1

Note: WDP4 locos are having only two traction motors per truck; hence only one speed sensor per truck can be disabled. WDG4 locos are having 3 traction motors per truck; hence any two speed sensor per truck can be disabled. One speed sensor per truck is always required for reference to computer

POWER GROUND

A power ground takes place when there is any grounding of the electrical power circuit. On WDP4 & WDG4 locos there are two types of power grounds

1.Ground relay - Dynamic brake
2.Ground relay - Power

In the first case when ground relay dynamic brake takes place, the loco pilot gets the following indications

1) Alarm }
2) No load } Observe on computer screen
3) TE meter drops }

GROUND RELAY- DYNAMIC BRAKE

Action by Loco Pilot:

Keep 1) Reverser – Neutral 2) Throttle -Idle

Computer will display RESET option above F3.
Press F3 function key to RESET

GROUND RELAY- DYNAMIC BRAKE REST

Note: If ground relay dynamic brake takes places 3 times with in 10 minutes DYNAMIC BRAKE LOCK OUT Takes place and computer screen displays as follows

NO DYNAMIC BRAKE
GROUND RELAY LOCK OUT

In such case cut out DYNAMIC BRAKE white slide switch on control panel and work onwards with out dynamic brake duly informing shed. Pass necessary remark in repair book.

In this **Second case** when Ground Relay—Power takes place the Loco Pilot gets the following indications

1) Alarm }
2) No load } Observe computer Screen
3) TE Meter drops }

GROUNDRELAYPOWER
RESET

F3

Action taken by Loco Pilot: Secure the control stand by keeping

1) Reverser - Neutral
2) Throttle - Idle
3) ER & GF - OFF
4) Isolation Switch - Isolate Side

GROUND RELAYPOWER
RESET

F3

After securing the control stand computer will display RESET option above F3, Press F3 function key to RESET the fault

Note: 1) In this way you can RESET two times
2) But, if three Power Grounds takes place within ten minutes computer will display **NO POWER GROUND RELAY-LOCK OUT**. This means there could be a problem existing in any one of the trucks.

NO POWER

GROUND RELAY- LOCK OUT

3) Disable one truck at time and move loco on power to identify defective truck, and clear section with one truck.
4) Check under truck for any shorting and smoking from traction motors cables
5) If trouble still exists after cutting out both trucks one at a time it means the problem could be with the ALTERNATOR
6) Check for any water accumulation in generator room or ECC 2 compartment and remove the same.

COMMUNICATION LINK FAILURE

1) A Communication link failure takes place when communication is lost between EM-2000 computer and TCC1 computer or TCC 2 computer or Event recorder or Micro air brake.
2) For example in case of communication link failure between EM-2000 and TCC 1 the computer will display a fault message as indicated

1) Alarm }
2) No load } Observe on computer screen
3) TE meter drops }

CODE 620

NO Load

TCC 1- Communication link failure

Action by loco pilot: Stop the loco and secure the control stand by keeping

1) Reverser - Neutral
2) Throttle - Idle
3) ER & GF - OFF
4) Isolation Switch - Isolate Side

Recycle the TCC 1 circuit breaker

Procedure for recycling:

1) Put OFF computer breaker
2) Put OFF TCC 1 circuit breaker

Wait for 20 seconds and put on circuit breaker in reverse order

1) Put ON TCC 1 circuit breaker
2) Put ON Computer circuit breaker (LAST)

Note: Recover penalty by keeping A 9 in FS for 10 seconds. In the same manner recycling can be done in case TCC 2, Event Recorder and Micro Air Brake (MAB)

CROW BAR

A crow bar is an electrical safety device to protect TCC 1 and TCC2 (A crow bar is not a defect or failure). If for any reason crow bar is fired following indication will be experienced.

1) Alarm }
2) No load } Observe computer screen
3) TE meter drops }

NO LOAD

TCC 1-Resistive Crow bar fired

Action by loco pilot: Secure the control stand by keeping
1) Reverser - Neutral
2) Throttle - Idle
3) ER & GF - OFF
4) Isolation Switch - Isolate Side

Now Recycle both the TCC 1 & 2 together procedure for Recycling

1) Put OFF computer breaker (FIRST)
3) Put OFF TCC 1 & TCC 2 circuit breaker

Wait for 20 seconds and put on circuit breaker in reverse order

3) Put ON TCC 1 & TCC 2 circuit breaker
4) Put ON Computer circuit breaker (LAST)

Note : Recover penalty by keeping A 9 in FS for 10 seconds

A FEW EXAMPLES OF MESSAGES APPEARING ON COMPUTER SCREEN AND WHAT ACTION LOCO PILOTS SHOULD TAKE AFTER FOLLOWING THE MESSAGE

1) **AUXILLIARY GENERATOR FAILURE**

When Auxiliary generator fails the following indication will be experienced

1) Alarm }
2) No load } Observe computer screen
3) TE meter drops }

CODE: 637

No communication Alternator Out-put. Check Auxiliary Generator field circuit breaker

Action by loco pilot: Stop the loco and secure the control stand by keeping
1) Reverser - Neutral
2) Throttle - Idle
3) ER & GF - OFF
4) Isolation Switch - Isolate Side

The following checks to done:

1) Auxiliary generator field circuit breaker is on or tripped
2) AGFB breaker in ON or tripped
3) AG output breaker is ON(in ECC 2 compartment) if tripped reset
4) Auxiliary generator drive shaft is broken/damaged
5) Green light of FCD module is burning
6) If non of the above observed recycle computer breaker and Auxiliary generator field circuit breaker as per procedure

2.AIR BRAKE FAILURE USE LOCOMOTIVE IN TRIAL ONLY:

When ever such a message appears the loco pilot should read the message and act accordingly.

AIR BRAKE FAILURE **USE LCOMOTIVE IN TRIAL ONLY**

The message means air brakes have failed on leading loco and the A 9, SA 9 will not work. If recycling and conduction self test there is no improvement then this loco is not fit to work as leading MU loco, so it should be used only as trailing MU loco taking power only to work with full load.

NOTE: If the MU leading loco engine has failed but air brakes are OK, the loco pilot can operate from leading loco, it self taking power of trialing MU loco.

WDP4 / WDG4

Locomotive Cranking Procedure

ENSURE THE FOLLOWING CONDITIONS BEFORE CRANKING:

1. Put on the hand brake.
2. Check oil and coolant water levels.
3. Make sure that LLOB on Governor, Low water and Low crank case pressure reset buttons are pressed in.
4. Make sure that Engine Over Speed Trip Reset Lever (OSTA) is in Reset Position (Handle should be tilted towards left side of locomotive in Reset position)
5. Make sure that the isolate / Run switch is in 'isolate' position.
6. On the Long hood console – Ensure
   - Engine Run switch is down (OFF)
   - Control & FP breaker is up (ON)
   - Generator filed switch is down (OFF)
   - MU shut down RUN button is pressed –in.
7. On working console –
   - Ensure Reverser handle in Neutral
   - Throttle handle in idle.
   - Keep Auto brake handle in RUN position.
   - Keep independent brake handle in Full application position
   - Keep Lead / Trail switch in Lead position.
8. On Non – Working console –
   - Ensure Reverser handle is removed.
   - Throttle handle in idle.
   - Auto brake handle is FS (Full service) position.
   - Independent brake handle in released position.
   - Lead / Trail switch is in Trail Position.
9. Ensure all circuit breakers on circuit breaker panel are in OFF position(Before cranking).

CRANKING PROCEDURE:

10.Ensure that start Fuse is in position and close the battery knife switch (ON)
11. On the circuit breaker panel

Put on BLACK labeled circuit breakers.
White labeled circuit breakers as applicable.
Yellow labeled circuit breakers (Turbo & Computer)

12. On computer select starting system Main Menu,
Data Meter
Starting system
13. TLPR shows on (Turbo Cooling Cycle Starts) Now engine is ready for cranking.

14. Go to the FUEL PRIME / ENGINE START switch and turn the switch to FUEL PRIME side (left side) if the shut down procedure was followed properly earlier, the fuel pump motor will start (the motor sound can be heard). If the fuel pump motor does not start, wait for 15-20 minutes and try again.

15. Keep holding the Engine PRIME / ENGINE START to prime side and see that the fuel secondary sight glass is full of fuel and shows no bubbles. Out of the two sight glasses, the one closest to engine block should be full with out any air bubbles and one away form the engine block should be empty.

16.Turn the Engine PRIME / ENGINE START switch to ENGINE START side and press the lay shaft gently to crank the engine. Release the lay shaft and the switch when you feel the lay shaft being pulled from your hand (only for WDG4 Locomotive) In case of WDP4 locomotives, start switch can be released when engine RPM goes above 160-180, which can be readily seen on the starting system screen on EM 2000. EPU RPM.

17. Caution: Excessive pressing of the lay shaft will over speed the engine and OST will trip causing the engine to shut down.

WDP4 / WDG4
LOCMOTIVE SHUT DOWN PROCEDURE

ENSURE THE FOLLOWING CONDITIONS BEFORE SHUT DOWN:

1. Put on the hand brake.
2. Turn isolate / Run switch to isolate position.
3. On the long hood console, keep
   - Engine Run Switch down (OFF)
   - Control & FP breaker up (ON)
   - Generator field switch down (OFF)

4. On the working console –
   - Keep Throttle handle in idle.
   - Keep reverser handle in neutral and remove the handle.
   - Auto brake handle in released position.
   - Apply independent brake to full application position.
   - Ensure Lead/ Trail switch is in Lead.

5. On the non-working console – Ensure –
   - Auto Brake is in full service position.
   - Independent brake is released.
   - Lead / Trail switch is in Trail Position.

SHUT DOWN PROCEDURE:

6. Select Starting system o computer to watch the status of TLPR. (Shows off)
7. Press EFCO (Red) button on the Control panel till the engine stops. (TLPR shows ON)
8. Make sure that the Turbo lube pump motor is running
9. Switch off all circuit breaker on the circuit breaker panel except turbo lube pump circuit breaker and computer circuit breaker.
10. Open battery knife switch.
11. Remove the Reverser and hand over to reliever or CCC.
12. Wait till TLPR goes OFF. (Turbo Cooling cycle competes)
13. Put off Turbo lube pump circuit breaker and computer circuit breaker.

DISPLAY MESSAGES:

MESSAGE : 1. GROUND REALY-- POWER RESET

- Stop The Train
- Keep Throttle in -------- Idle
- Keep Reverser Handle------- Neutral
- Keep Isolation switch ------ Isolation
- Put OFF ER and GF
- Press F3 for RESET
- GR will reset automatically
- In this way GR can reset TWO times only
- If 3rd time power ground rakes place with in 10min EM-2000 shows:
  NO POWER -- GROUND RELAY LOCK OUT
- Check loco / under truck any smoke or smell comes if not
- Isolate truck-1 or truck-2
- If troubles still exists means the problem could be in ALTERNATOR
- Check any water accumulated in generator room and ECC2 compartment remove the same

MESSAGE : 2. GROUND REALY -- DYNAMIC BRAKE

- Stop The Train
- Keep Throttle in -------- Idle
- Keep Reverser Handle------- neutral
- Keep Isolation switch ------ Isolation
- Put OFF ER and GF
- Press F3 for RESET
- GR will reset automatically
- In this way GR can reset TWO times only
- If 3rd time power ground rakes place with in 10min EM-2000 shows :
  NO DYNAMIC BRAKE -- GROUND RELAY LOCK OUT.
- Put OFF DB slide switch, don't use DB and work onwards

MESSAGE: 3. NO LOAD -- NO COMPANION ALTERNATOR OUTPUT CHECK AUX-GEN FIELD BREAKER. NO AUX-GEN OUT PUT CHECK AUX-GEN FIELD BREAKER

- Keep Throttle in -------- Idle
- Keep Reverser Handle------- neutral
- Keep Isolation switch ------ Isolation

- Put OFF Computer Control breaker
- Put OFF AUX-GEN FB breaker

Wait for 20 sec then put on breakers in reverse order, keep isolation switch in run and A9 in FS for 10sec then bring it to RUN

MESSAGE: 4. AUXLLIARY GENERATOR FAILURE

- Keep Throttle in -------- Idle
- Keep Reverser Handle------- neutral
- Put off ER and GF
- Keep Isolation switch ------ Isolation
- Put ON AUX-GEN FB breaker if tripped
- Put ON AUX-GEN FLD breaker if tripped
- Put ON AUX-GEN breaker in ECC-2 if tripped
- Check Auxiliary Generator drive shaft broken
- If non of the above observed
- Put OFF Computer Control breaker
- Put OFF AUX-GEN FB breaker
- Put OFF AUX-GEN FLD breaker
- Wait for **20**sec then put on made breakers in reverse order, keep isolation switch in run and A9 in FS for **10**sec then bring it to RUN .

MESSAGE: 5. NO LOAD TCC#1 COMMUNICATION LINK FAILURE
NO LOAD TCC#2 COMMUNICATION LINK FAILURE

- Keep Throttle in -------- Idle
- Keep Reverser Handle------- neutral
- Put off ER and GF
- Keep Isolation switch ------ Isolation
- Put OFF Computer Control breaker
- Put OFF TCC#1 AND TCC#2 breaker
- Put OFF ACGTO-1 and ACGTO-2 breaker
- Put OFF Micro Air breaker
- Wait for **20**sec then put on made breakers in reverse order, keep isolation switch in run and A9 in FS for **10**sec then bring it to RUN .

MESSAGE: 6. CROW BRAR FIRED ALONG WITH TCC

- Keep Throttle in -------- Idle
- Keep Reverser Handle------- neutral
- Put off ER and GF
- Keep Isolation switch ------ Isolation
- Put OFF Computer Control breaker
- Put OFF TCC#1 AND TCC#2 breaker
- Put OFF ACGTO-1 and ACGTO-2 breaker
- Put OFF Micro Air breaker
- Wait for **20**sec then put on made breakers in reverse order, keep isolation switch in run and A9 in FS for **10**sec then bring it to RUN .

MESSAGE: 7. COMMUNICATION LINK FAILURE-MAB (BP DROPPED TO ZERO)
Action to be taken

- Keep Throttle in -------- Idle
- Keep Reverser Handle------- neutral
- Keep Isolation switch ------ Isolation
- Put OFF Computer Control breaker
- Put OFF Micro Air breaker
- Wait for **20**sec then put on made breakers in reverse order, keep isolation switch in run and A9 in FS for **10**sec then bring it to RUN .

If Not Succeed
Check the power coupler of "VCU" (voltage condition unit) available in airbrake rake just above the dead COC if still trouble occurred conduct airbrake self test.

MESSAGE: 8.NO-LOAD PCS OPEN AND PENALTY COULD NOT RESET

- "CRU" unit coupler may be slacked
- couple properly "CRU" near (voltage condition unit) in airbrake rake just above the dead COC

MESSAGE: 9. # 2 LOCKED WHEEL DETECT –CHECK WHEEL ROTATION

- Stop the train
- Check the wheel No .2 rotation
- If wheel is rotating suspect sped sensor fault
- Keep Throttle in -------- Idle
- Keep Reverser Handle------- nutral
- Put off ER and GF

- Keep Isolation switch ------ Isolation
- Press main menu
- Press locked wheel detect, select sensor and press F1
- Disabled sensor No.2

MESSAGE: 10.LEAD/TRAIL MODE SELECTION FAILURE

- Any mistake done while changing console the above message comes
- Keep A9 in emergency for 60sec ,then bring it to RUN

MESSAGE: 11. NO ENGINE START –TURBO PUMP NOT RUNNING RUN PUMP FOR 15 MIN TO COOL TURBO

Action to be taken

- Put OFF Computer Control breaker
- Wait for **20**sec
- Put ON Computer Control breaker
- Turbo lube pump will run wait 15MIN then crank the loco

PROCEDURE FOR ISOLATION OF TRUCK-1 OR TRUCK-2

- first stop the train
- Keep Throttle in -------- Idle
- Keep Reverser Handle------- Center
- Keep Isolation switch ------ Isolation
- Put off ER and GF
- Press main menu
- Select traction cut out press F3
- Select **Truck-1** or **Truck-2** press F3 wait **5**sec
- First clear the section inform to PRC,60% of load permit

DEAD LOCO ATTACHING NEXT TO ENGINE (WITH ANY LOCO) WITH BRAKE APPLICATION

- Secure the loco as per procedure
- Shutdown the engine drain out MR-1 and MR-2 pressures fully and close the drain valves

On Both Consoles

- Keep auto brake(A/B) in FS
- Keep direct brake in release

- Keep L/T switch in trail
- Open dead engine COC in airbrake rake (kept in vertical)
- Couple BP pipes of both locos and open Angular COC's
- Open BC equalizing & MR equalizing COC's at any one end.

LOCO ATTACHED AS LIVE NEXT TO ENGINE OR DOUBLE HEAD OPERATION (WITH ANY LOCO) OR BANKING OPERATION WITH BRAKE APPLICATION

- Couple both CBC's
- Keep Isolation switch ------ Isolation (only when carrying the loco in idle condition).
- Keep one console as non-working .
- On working console Keep auto brake(A/B) in FS, Keep direct brake in release
- Keep L/T switch in Helper
- Couple BP pipes of both locos and open the COC's
- Wait for penalty for once , after that crew message will come that air brake penalty , to release keep A/B handle in FS for 10 sec's since handle already kept in FS wait for next message , after 10sec's penalty will release and crew message will come that to restore normal air brake operation keep A/B handle in Run. Don't keep A/B handle in run , now you can start the train from Leading working loco.

Note : During double head operation if crew is not available for trailing loco , provide MU Jumper cable and make locos as MU electrically , but air brake side MU connections not required , air brake side same procedure is to be followed as described above.

PROCEDURE OF CHANGING DIRECTION OF MU LOCOS

- Secure the locos as per procedure
- On leading loco convert working console as non-working as per procedure.
- Now in trailing loco convert required console as working as per procedure.
- In trailing loco **PUT ON** the engine run switch, generator field switch and control & fuel pump switch
- In leading loco **PUT OFF** the engine run switch, generator field switch and control & fuel pump switch.

GENERAL DATA OF WDP1

DIFFERENCES OBSERVED IN WDP1 COMPARED TO WDM2

Sl.no	Description	Values/ data
1	LENGTH OF THE LOCOMOTIVE	14810mm
2	HEIGHT OF THE LOCO	4180mm
3	WIDTH OF THE LOCO	2864mm
4	WEIGHT OF LOCO	80 tonnes
5	AXLE LOAD	20 tonnes
6	WHEEL DIA NEW	1092mm
7	WHEEL DIA (HALF WORN)	1055 mm
8	WHEEL ARRANGEMENT	Bo-Bo type
9	SERVICE	Passenger traffic
10	BRAKE SYSTEM	28 lav1
11	BRAKE ARRANGEMENTS	TBU type (along with parking brake)
12	CONTINUOUS SPEED(MINIMUM)	29 kmph
13	MAXIMUM SPEED	140 kmph
14	T.M. COMBINATION	Direct parallel
15	EXCITATION CONTROL	'e'- type
16	IDLE R.P.M	400
17	8TH NOTCH RPM	1000
18	OSTA	1120 (±40, 10)
19	DSL ENGINE HP	2300 hp
20	INPUT TO TRACTION ON 8TH NOTCH	2150 hp / 1950 hp
21	MAXIMUM TRACTION ON RAIL(STARTING)	20000 kg
22	MAXIMUM TRACTIVE EFFORT ON RAIL (CONTINUOUS)	16400 kg
23	TYPE OF ENGINE	Alco 281b, 12 cyl v type
24	CYCLE	4 stroke
25	FIRING ORDER (D.E)	R/L 1,4,2,6,3,5

26	EXPRESSOR UNIT (AIR & VAC)	6cd-3uc (ke-6)
27	TRANSMISSION	Ac/Dc
28	FUEL OIL TANK CAPACITY (DETACHABLE)	3000 ltrs
29	LUBE OIL CAPACITY	760 ltrs
30	COOLING WATER CAPACITY	1210 ltrs
31	TURBO	Napier bap 19
32	WATER LEVEL INDICATOR	Near long hood head light

ADVANTAGES OF WDP1

1. Reduction in fuel consumption
2. Reduction in lube oil consumption
3. Reduced in maintenance cost
4. Air resistance on higher speed is reduced with the aero dynamic shape of the loco on short hood side
5. Loco provided with 28 lav1 brake system there by loco can work on air & vaccum brake stock
6. Loco is 13%fuel efficient than wdm2 loco's when 17 coaches are run with 100kmph speed
7. Loco equipped with more powerful TBU type brake system along with parking brake
8. No. of engine cylinders reduced to 12 ,no and T.M reduced to 4.and D.B removed there by manufacturing cost of the loco is reduced
9. When compared to other wdm2 locomotives speed of the loco is higher i.e130kmph
10. Loco is provided with direct parallel combination there by loco will attain the speed fast with in less time

OTHER IMPROVEMENTS IN WDP1

1. Modified control stands and control drums(similar to WDM 3A and WDG 3A locos)
2. Alpha make digital water temperature scanner
3. TDR relay, CKC and CK3 contactor (like WDM 3A)
4. GFOLR Relay (like Ac/Dc locos)
5 wheel type master control(like WDM 3A)

6 Panel mounted 28lav1 brake system in nose compartment
7. TBU type loco brake system with parking brake
8 EPG toggle switch(in s.h.c.s)

ABBREVIATIONS

TBU	TREAD BRAKE UNIT
TDR	TIME DELAY RELAY
GFOLR	GENERATOR FIELD OVER LOAD RELAY
LAS	LOAD AMMETER SHUNT
ACCR	ARMATURE CURRENT CONTROL REACTOR
BAS	BATTERY AMMETER SHUNT
ETR	ENGINE TEMPERATURE RELAY
OVD	OSCILLATOR VOLTAGE DIVIDER
RCD	REVERSE CURRENT DIODE
EPG	ELECTRO PNEUMATIC GOVERNOR
FWD	FREE WHEEL DIODE
VDP	VOLTAGE DIVIDER PANEL
GFR	GENERATOR FIELD RESISTOR
LCR	LOAD CONTROL RESISTOR
ASR	ARC SUPPRESSION RECTIFIER
CKC	CRANKING CONTACTOR RELAY

MODIFICATIONS IN WDP1

1. Detachable type of fuel oil tank with 3000lts capacity
2 Capacity of lube oil 760lts
3. 2300/2150 H.P with 12 cylinders 'V' type 4stroke
4. TBU type loco brake system
5. No dynamic braking.
6. 28 lav1 brake system (dual)
7. Since there is no dynamic brake master control is not provided with braking range

8. No BKT
9. No M&B handle
10. Fabricated BO-BO type
11. No sand gear
12. 4no.s of T.M
13. POWER CONTACTORS are also only 4 (p1,p2,p3,p4)
14. FS contactors are 4. And WSR are 2
15. Direct parallel transition and with shunt at 48kmph
16. FS contactors and FSRR's are located inside panel in nose compartment
17. PCs, hs4 are also mounted on the brake system panel in nose compartment
18. GFOLR located in the centre of the front panel of control compartment in between the p4 power contactor and RCD
19. 1 and 3 traction motors gear cases are on the left side and 2 and 4 traction motor gear cases are on the right side
20. Only one reversor

ALCOHOLISM

No railway servant shall while on duty, whether he is directly connected with the working of trains or not be in a state of intoxication or in a state in which, by reason of his having taken or used any alcoholic drinks, sedative, narcotic or stimulant drugs or preparation, his capacity to perform his duty impaired.

No railway servant directly connected with working shall take or use any alcoholic drink, sedative, narcotic or stimulant drug or preparation with in 8 hours before the commencement of his duty or take or use any such drink, drug or preparation while on duty.

It shall be obligatory on the part of the every supervisor to ensure that any staff working under his control or not allowed to join duty if they are in a state of intoxication or under the influence of alcohol.

At the crew/Guard booking points the in charge shall ensure that the Driver/Dsl. Asst./Guard are subjected to 'Breath analyzer test while signing 'on' as well as signing 'off' duty.

Alcoholism is a decease caused by continual heavy drinking alcohol. It is a decease in which a person has on overwhelming desire to desire to drink alcoholic beverages. The person who has the decease is called as 'alcoholic'. A person may drink occasionally but they do not make him an alcoholic, as alcoholic feels to force to drink.

Effects:

Alcohol is a drug that lowers the activity of the nerves system. Specifically alcohol affects the control circle of the brain. As a result, intoxicated people may loose the self-control and behave in ways that are unacceptable to others. They may experience mental confusion and inability to perform duties steadily.

Heavy drinking of alcohol can produce more serious effects such as,

- **Physical**
  - Mental confusion
  - Violent trembling
  - Hallucinations (visions)
  - Paralyzes the hands and feet
  - Loosing memory
  - Damage to lever, kidney and finally they end in very painful death.

❖ **Social**

- Decay of social relation ship
- Problems in his duty
    a) Poor concentration
    b) Poor health
    c) Poor memory, weakness

- Family problems
- Drinking by obtaining loans from friends and neighbors giving so many false reasons.
- Mental disorder.
- Mental fear.
- Reporting late for duty.
- Eager to leave duty early.
- Improper HOC/TOC.
- Adopting short cut methods.
- Not able to do the simple normal work like buttoning shirt, zipping and tying his dhoti.

Alcoholism may lead even a good Driver to commit mistakes. The train handling skill of the good Driver will also deteriorate due to mental and physical in balance.

Drunkenness on Duty.

All train operating staff please note.

Indian conditions the following safety limits are laid down for the presence alcoholic in blood and urine.

1. Between 01- 20 mg/100ml – The person concerned will not be allowed to perform duty
2. Between 21 – 40 mg/100ml blood is dangerous.
3. Between 41 – 70 mg/100ml blood is very dangerous.
4. Beyond 70 my/100ml blood – requires immediate action.

* * *